Relations in Architectural Space

Designs and Effects in Space of the Traditional Thai Houses and Temples

Volume Two

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5. The Analysis: Part I: from abstraction...

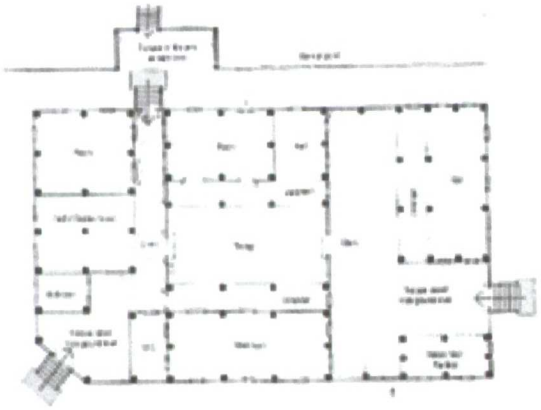
The analysis in this chapter is an extended version of the analytical procedure outlined in chapter three. Derived from the same theoretical argument outlined in chapter two, the analysis covers many more spaces of different types and designs, making the information about architectural space and its dimensions more solid in detail and specific to particular use in design. Using houses and temples from Thailand as examples, the analysis deals with the most basic built environment as well as specific ones. Chapters five, six and seven may be seen as one piece of work conducted in a sequence that replicates the process by which space becomes architectural reality. The basic concept of the analysis is the interaction between bodily movement in space and the built environment. It is therefore based on an understanding of architectural space as a concept derived from an architect's design process in structuring 'emptiness' for intelligible movement in various functions using corresponding architectural elements.

The idea of relations among different dimensions of architectural space seems to suggest that there are specific rules or relational syntax in the process of 'abstraction to architectural reality'. These relational syntaxes are formed according to people's common expectations of architectural space e.g. a doorway is usually an opening in a wall connecting two different spaces, a staircase will not end at the ceiling or go through a window etc. The relational syntax makes sense of architectural space because of its intrinsic nature within each dimension (element) in a relation (a syntax). It also has the characteristic of a diagram that outlines the whole identity of such space in a real physical context. The relational syntax is, in this way, an indication of relations in space which is used and referred to in different ways and strategies by users and architects. Consequently, it has notational potential and could be choreographed.

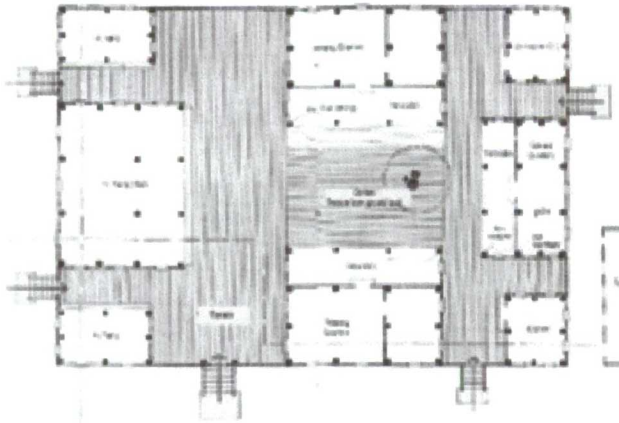
The analysis will start from the structural dimension of space in the selected houses and temples followed by experiential, functional and architectural-element dimensions. There are seven sections in the upcoming analysis: 1) convex analysis, 2) justified graph analysis, 3) theoretical analysis, in chapter five and, 4) syntactic analysis, 5) design analysis, 6) route analysis in chapter six and 7) relation analysis in chapter seven. Because of its numerical explanation of space, the syntactic analysis is the conclusion of the abstract side of the analysis: convex space, justified graph and theoretical analyses, and the link to the

'architectural' side: design and route analyses in chapter six. In each analysis, data are presented in both tables and illustrations; house spaces are analysed first followed by temple spaces. The analysis employs information from on-site observations and architectural plans of the selected examples (Figures 5.1-5.2).

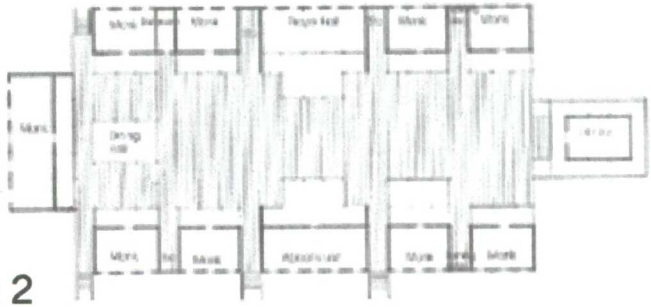
'space' in the analysis is based on the concept of convex spaces which make up a configuration from the seemingly continuous space of a building. Formed by the idea of topological relation in social activities, a convex space is quantified from topographical settings of the built environment (Hillier and Hanson, 1984). It can be seen as negative space inside the layout of architectural elements of walls, columns, stairs, floors, doors, windows etc. that make up architectural plans. Structurally, every convex space in every building has all basic syntactic values: integration and control value and connectivity (Hillier, Hanson and Graham, 1987). In this research a convex space is further defined and conceived as a full three-dimensional object that fits seamlessly with architectural reality as shown in axonometric drawings. Convex spaces are transparent and ephemeral. That is why the research employs on-site observation to identify with their reality and to help quantifying them.



House 1

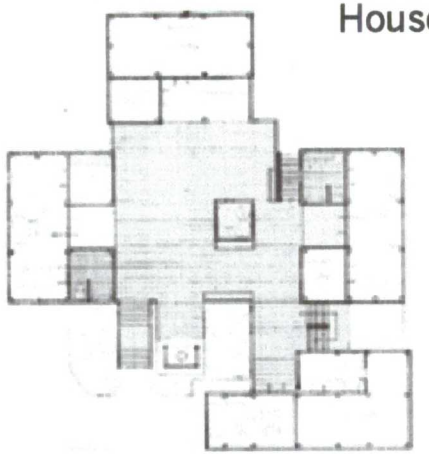


House 2

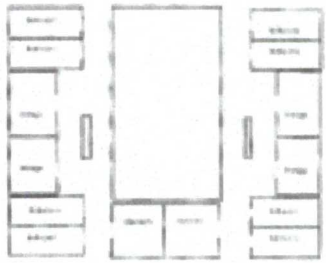


House 3

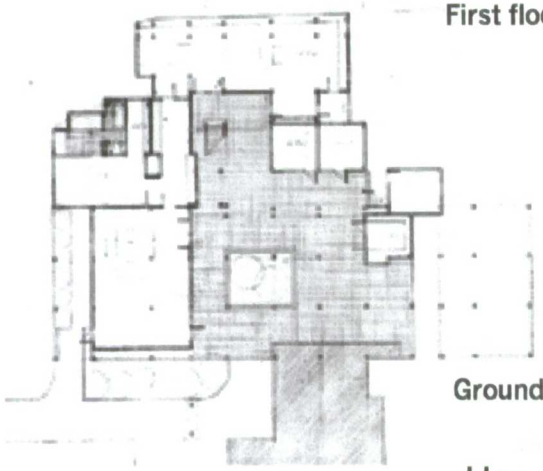
First floor



First floor

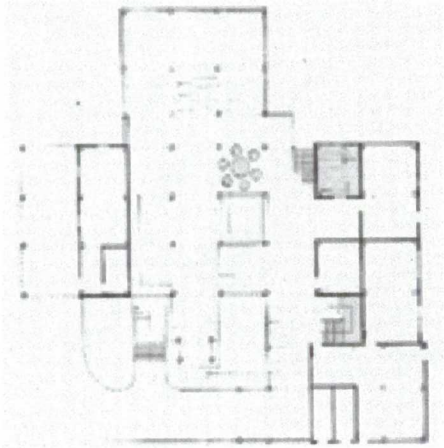


Ground floor

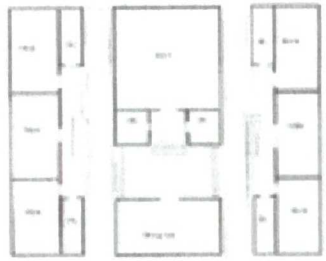


Ground floor

House 4



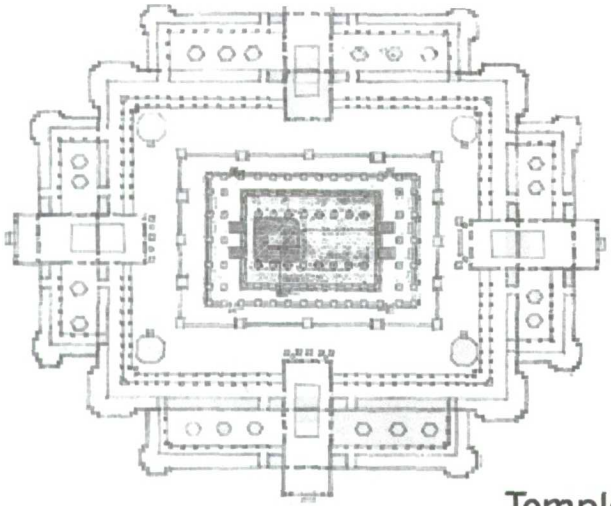
House 5



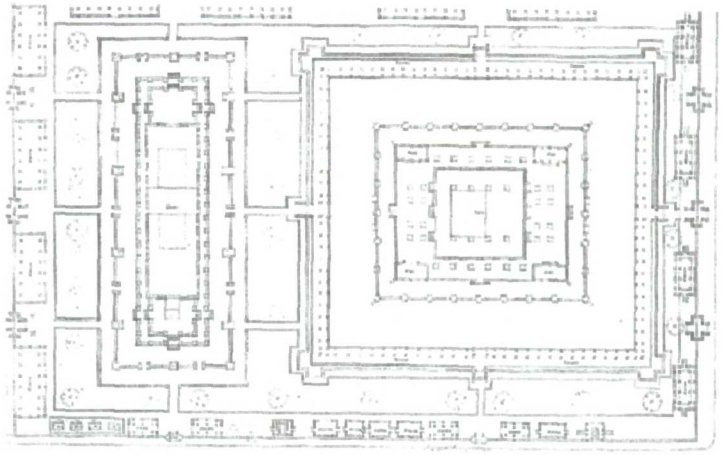
First floor

House 6

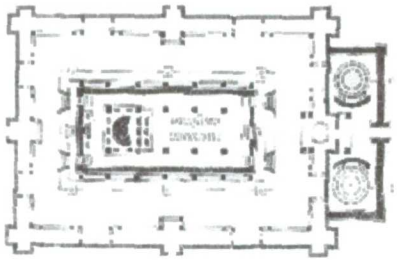
Figure 5.1 Houses 1- 6



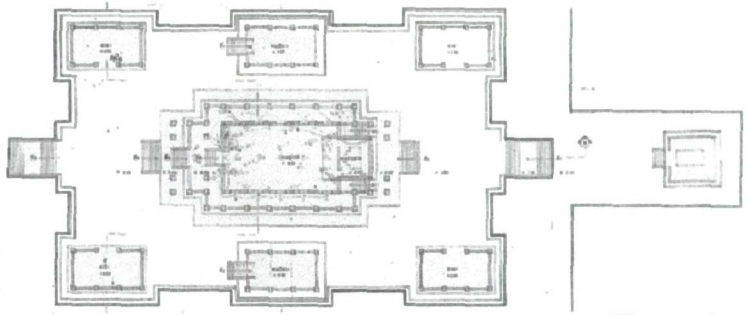
Temple 1



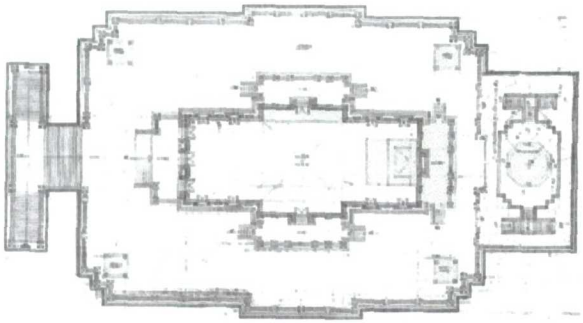
Temple 2



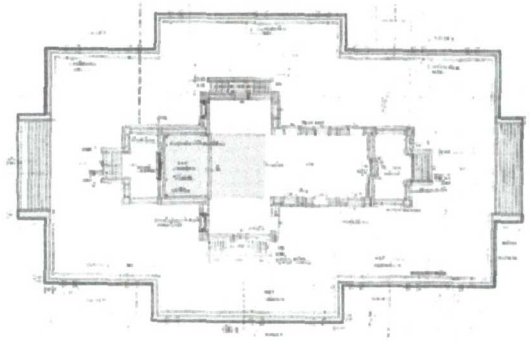
Temple 3



Temple 4



Temple 5



Temple 6

Figure 5.2 Temples 1-6

5.1 Convex space analysis

Numerical data: Tables 5.1-5.2 (p.183)

Graphical data: Figures 5.1-5.16

The convex spaces in the selected examples will first be seen as open spaces where space is not rigidly defined by walls, enclosed spaces inside rooms, halls etc. and connecting spaces, e.g. doorway, gateway and stairs. These three properties of space are present in order to establish broadly physical descriptions of the selected buildings. It provides an overall understanding of a building as an 'organisation' of occupiable space. When designers or users deal with a building, this notion of space seems to be the most immediate to their senses; that is, the selected buildings are introduced as a whole before further detailed analyses. In this way, this analysis investigates the issues of axis, zoning, orientation, expansion, compactness, simplicity and complexity in the designs of Thai architecture.

Convex space analysis of the selected Thai houses

In Thai houses, space is architecturally transformed only on the raised platform whereas space under the platform, even though it is used for various functions, is very much part of the environment (Figure 5.1). The selected examples are the combination of these conventional Thai houses on the raised platform and the contemporary ones that are two-storey houses. Upon entering Thai houses, what one usually finds most striking is a vast 'open space' called *chan* that spreads throughout the whole house. All the main circulation takes place on *chan* before passing through the 'connecting spaces' of doorways and stairs to the 'enclosed spaces' of detached rooms. The convex spaces on *chan* are usually very straightforward and simple. However, in three dimensions these convex spaces are much more complex than they appear in plans. In Thai houses, the locations of individual living units and the whole compound are based on the concept of movement in open space making the architecture very dynamic, not in a mechanistic way but in a holistic sense of all dimensions in space. Any investigation of spaces of Thai houses must include ephemeral aspects of their open spaces in order to address the architecture's real identity.

Traditional Thai House: **Houses 1 – 6**: Convex space				
House	Open space(*Chan*): no. (%)	Enclosed space (room): no. (%)	Connecting space (doorway & stairs): no. (%)	Total
House 1	10 (29)	9 (26)	16 (**46**)	35
House 2	17 (40)	10 (24)	15 (36)	42
House 3	34 (**56**)	14 (23)	13 (21)	61
House 4	41 (45)	24 (26)	26 (29)	**91**
House 5	23 (40)	21 (36)	14 (24)	58
House 6	16 (30)	28 (**53**)	9 (17)	53
Total/Average (%)	141/24 (42)	106/18 (31)	93/16 (27)	340
Total space = **340** + 6 exterior spaces				

Table 5.1: Convex space of Houses 1 – 6

Traditional Thai Temple: **Temples 1 – 6**: Convex space				
Temple	Open space (e.g. terrace): no. (%)	Enclosed space (room): no. (%)	Connecting space (e.g. door/gateway and stairs): no. (%)	Total
Temple 1	568 (**76**)	51 (7)	124 (17)	743
Temple 2	690 (59)	260 (**22**)	218 (19)	**1168**
Temple 3	87 (67)	18 (14)	26 (20)	130
Temple 4	93 (71)	11 (8)	27 (21)	131
Temple 5	93 (66)	6 (4)	43 (30)	142
Temple 6	24 (44)	4 (7)	27 (**49**)	55
Total/Average (%)	1555/259 (66)	350/58 (15)	465/78 (20)	2369
Total space = **2369**+ 6 exterior spaces				

Table 5.2: Convex space of Temples 1 – 6

The conventional Thai houses:

Even though it was built for King Rama V, house 1 was designed as a traditional Thai house for ordinary people (Figure 5.3). The house has 35 convex spaces; 10 of them are terrace or *chan* spaces (29% including verandas) and 9 enclosed convex spaces of detached rooms. The largest proportion of house 1's space is connecting spaces (46%) which is the highest in all houses because of a strong emphasis on doorways and stairs in Thai houses. The house was designed in such a way that it can be turned into three separate parts with three key spaces. Space 7 connects the front with the middle part at space 9 which is connected with the back part at space 20. All of these key spaces are open spaces on the *chan* which is asymmetrically organised to be partially closed from one through movement. Space 9 can be sectioned into an open-air room by shutting two connecting spaces at spaces 8 and 19. This effect, however, is not clearly visible from the plan or even from photographs. Conventional Thai houses may look similar to one another because of the design principle of detached living units and their architectural features but convex space analysis and on-site experiences reveal that each house has its unique spatial configuration from the design of its open space.

House 2 is slightly bigger than house 1 but they are quite similar in terms of zoning and convex space organisation (Figure 5.4). There are 17 open spaces, 10 enclosed spaces and the second largest proportion of connecting space of all houses (36%). A big open space 3 at the front part connects to the middle part of the house at space 18 which is located in between two main living units. Space 18 provides both access and privacy for these units; it connects to the back part at space 27. Spaces 3, 18 and 27 are *chan* spaces that control accessibility to the three main parts of the house. Their roles are similar to those of the three key spaces in house 1 except that in this house they are symmetrically arranged on one axis. House 2 has large open space (40%); once one is on *chan* space, the whole space can be well perceived from almost everywhere. Its enclosed spaces (24%) are almost part of the open space when the living units' doors are open creating an impression of a big common space in this living compound. The house's simplicity is achieved through its symmetrical organisation of convex space along its longitudinal axis. The design creates a spatial configuration which allows flexibility and simplicity at the same time.

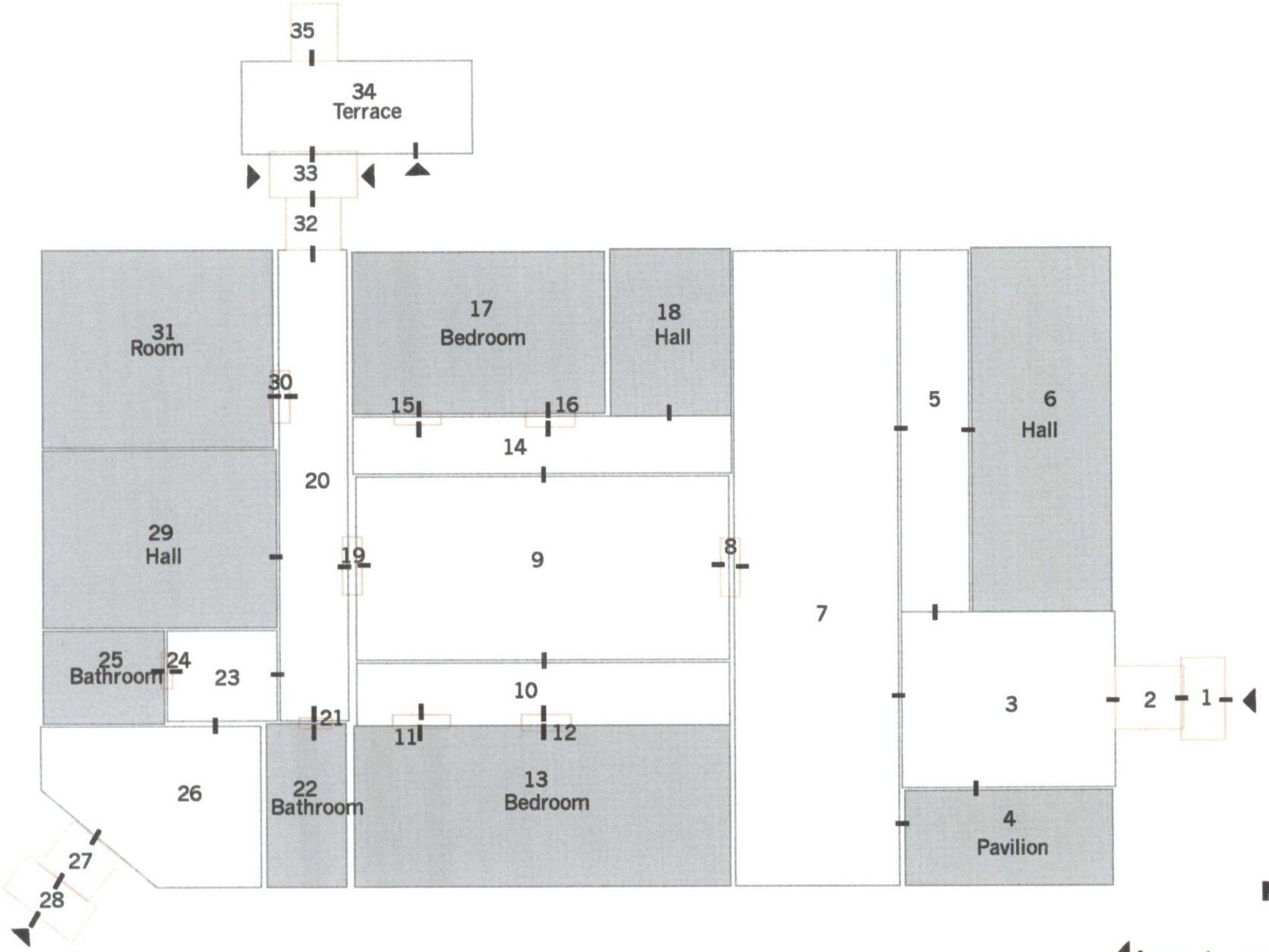


Figure 5.3 House 1 Convex space analysis

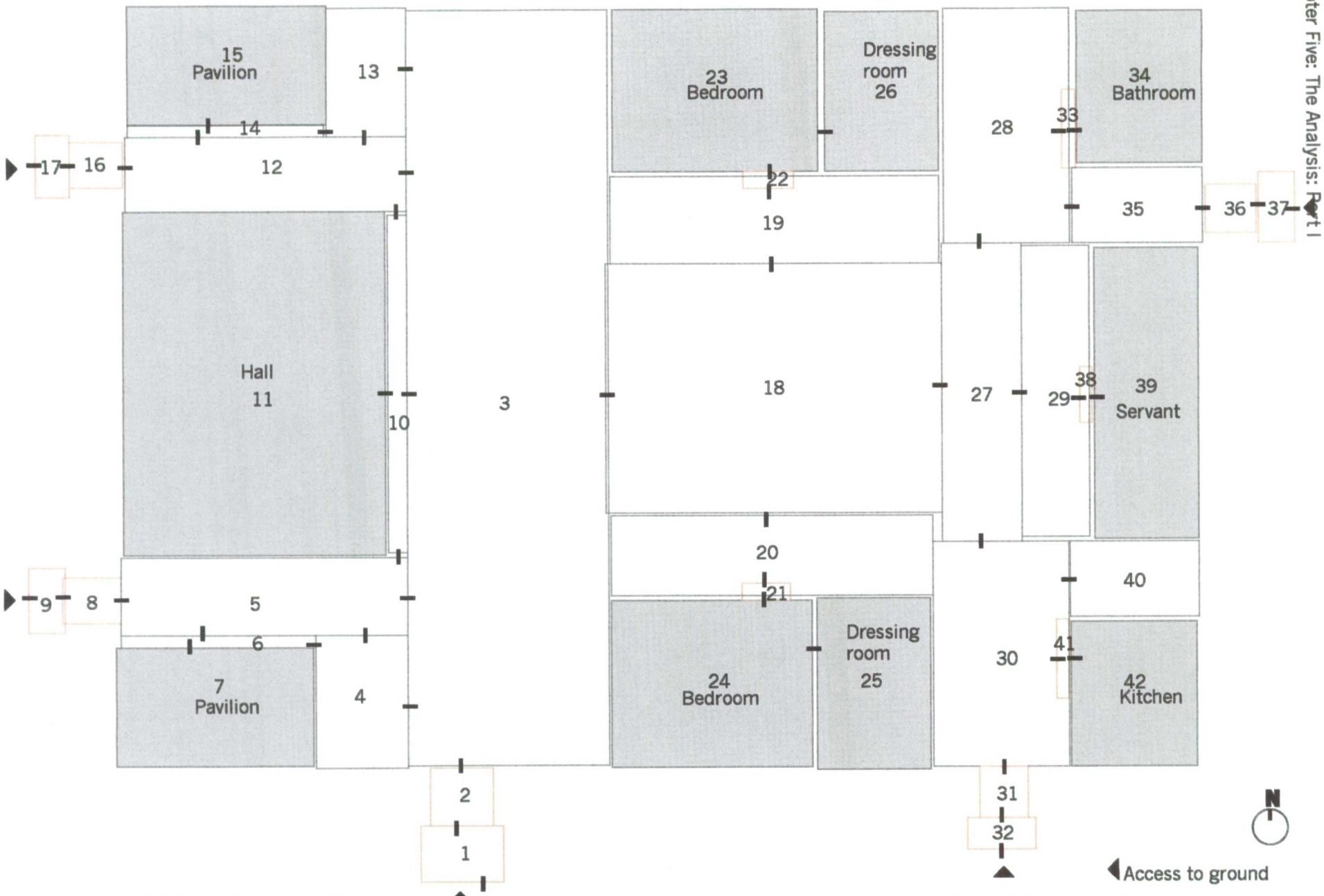


Figure 5.4 House 2 Convex space analysis

House 3 is very similar to house 2 because their convex spaces are both symmetrically organised around the longitudinal axis making quite formal spatial configurations (Figure 5.5). House 3 has 61 convex spaces with 34 open spaces (56%), the largest proportion in the selected houses resulting in a totally connected experience. The house is the monks' living compound where the living units are separated from one another by shared convex spaces of entrances, bathrooms, storage and bathing areas. The other shared spaces such as the dining hall and library are placed at the ends of its longitudinal axis whilst religious-based convex spaces like the abbot's unit and prayer hall are placed on the sectional axis. In this house, zoning can be achieved in three dimensions without physical partitions in its open space. For example, the floor was raised and the roof was put over the *chan* space (space 41) to create different zones in its long spatial configuration. This also creates two loci of common areas (spaces 33 and 46) with shared facilities of dining hall (space 2) and library (space 58). The same number of living units shares these two common open spaces.

The contemporary Thai houses:

House 4 has contemporary characters and design (Figure 5.6). It has the second largest proportion of open space (45%) and the highest number of convex spaces (91). Unlike typical Thai houses, there are no major axes in house 4's configuration because the house has become complex through many adaptations. The major principle is still the design of detached living units around an open *chan* space on the raised platform which strongly influences the spatial configuration of the ground floor. These two levels of convex space are spatially connected through the open well over the garden space. The house acquires most of its back part (spaces 21-43) through an extension which makes the organisation of the convex space on the ground floor quite fragmented. This part of the house increases the complexity of the whole configuration and creates a large proportion of connecting spaces (29%). Most extensions on the ground floor branch . out from the courtyard which follows the shape of *chan* space on the first floor. Spaces 23 and 25 provide access to the new zone of the house and are the new axes toward the back.

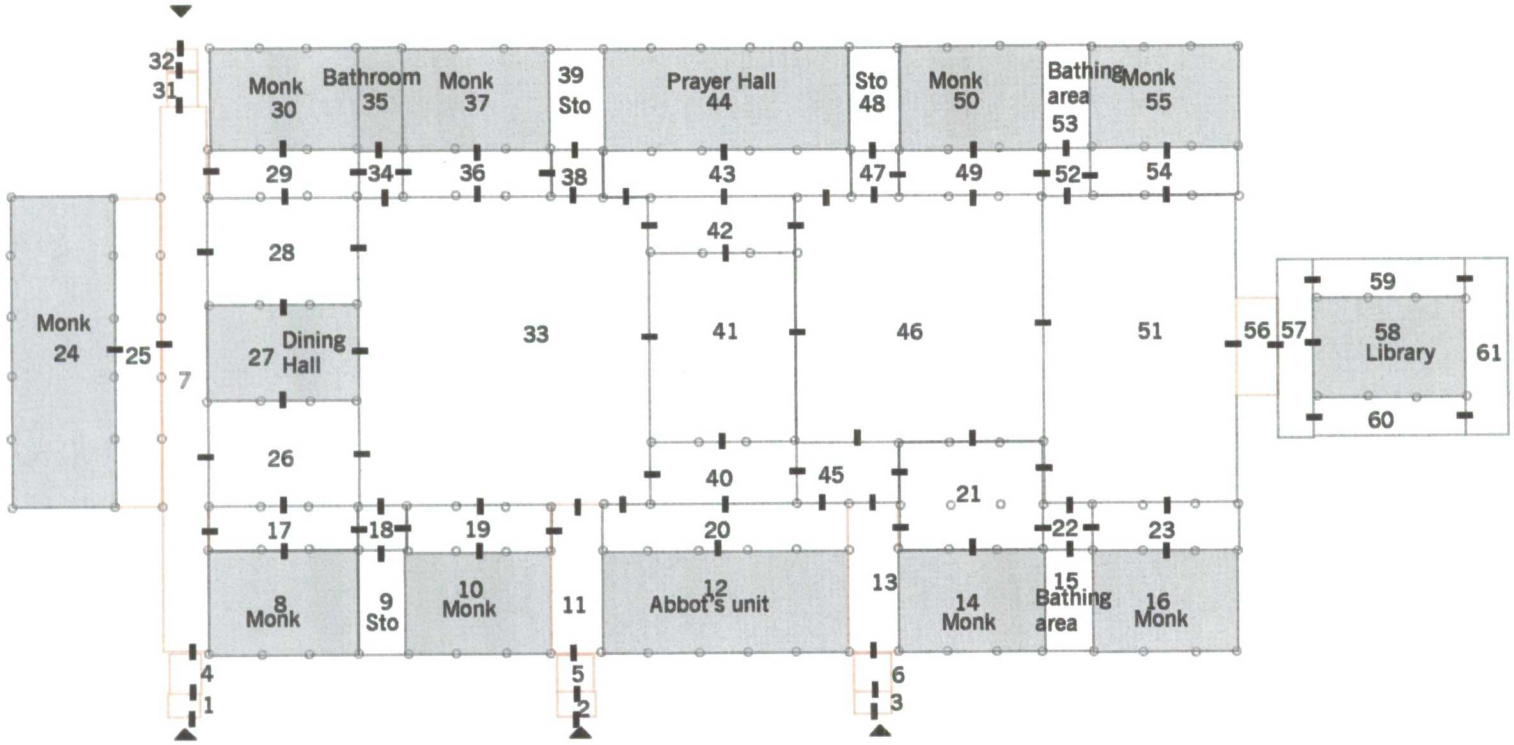
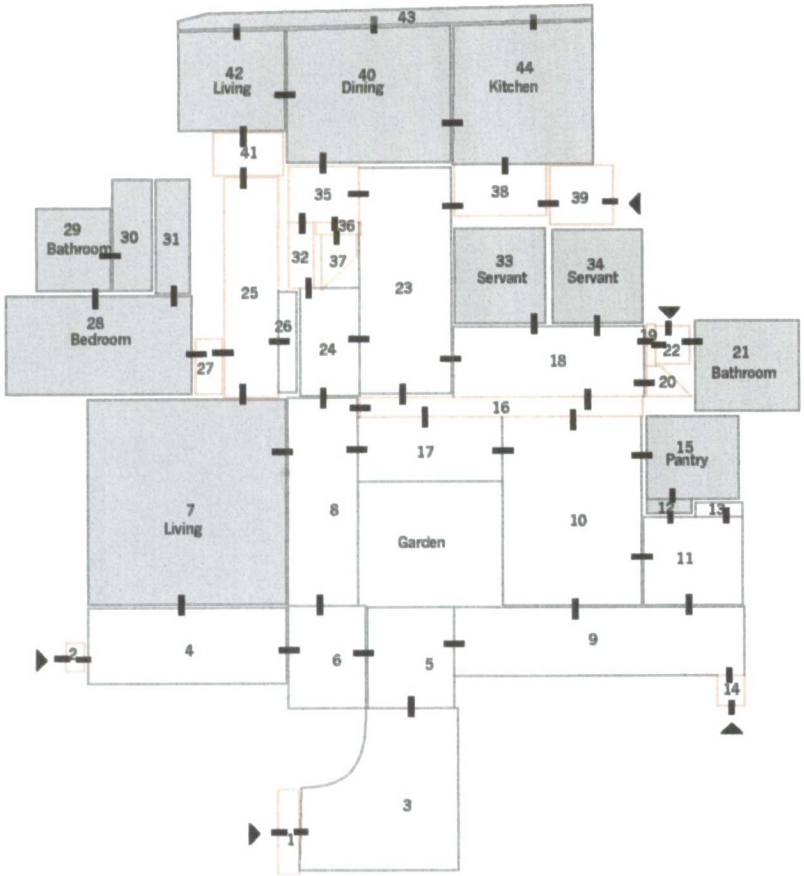
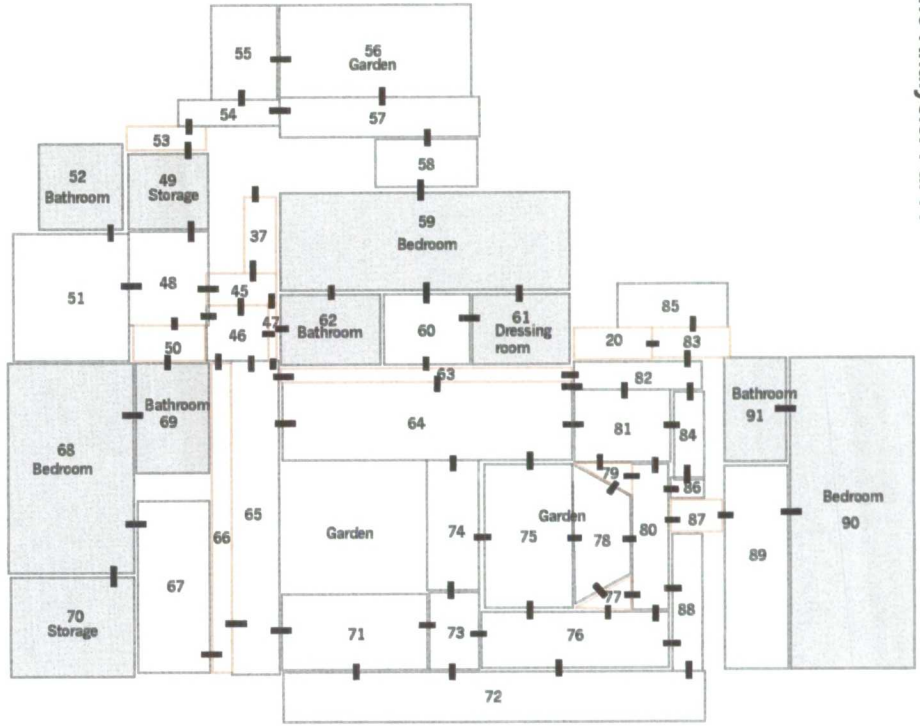


Figure 5.5 House 3 Convex space analysis



Ground floor



First floor

N

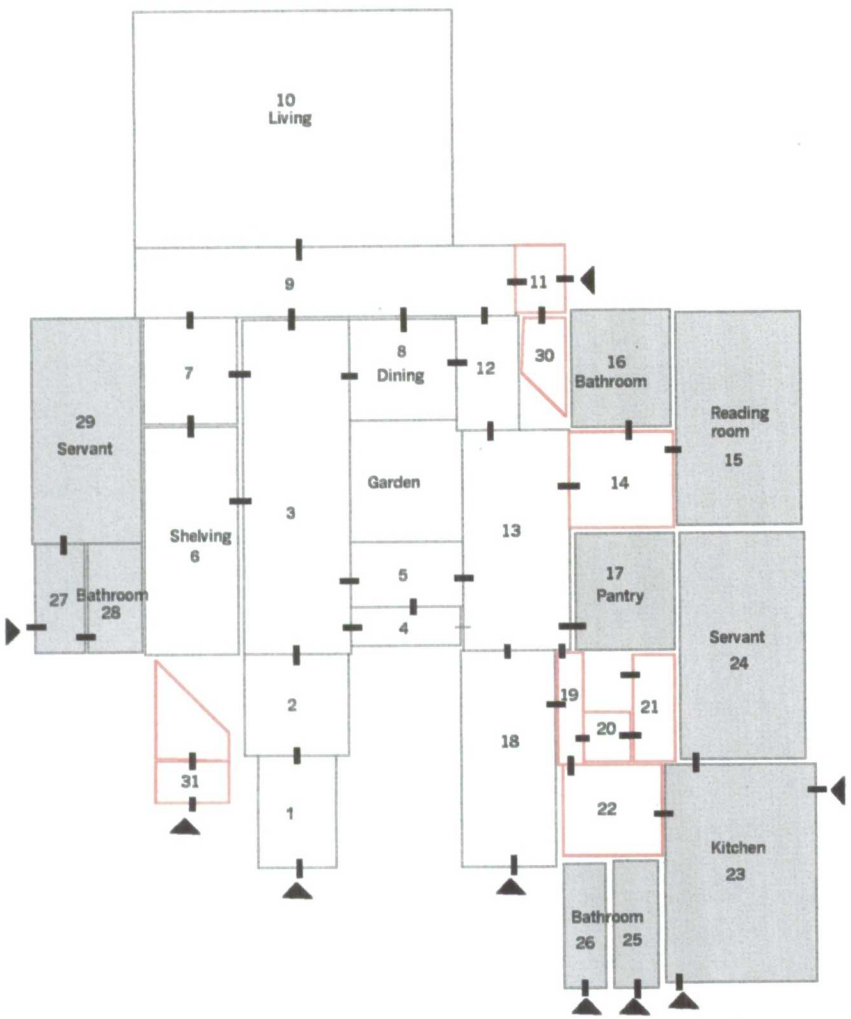
Access to ground

Open space Connecting space Enclosed space

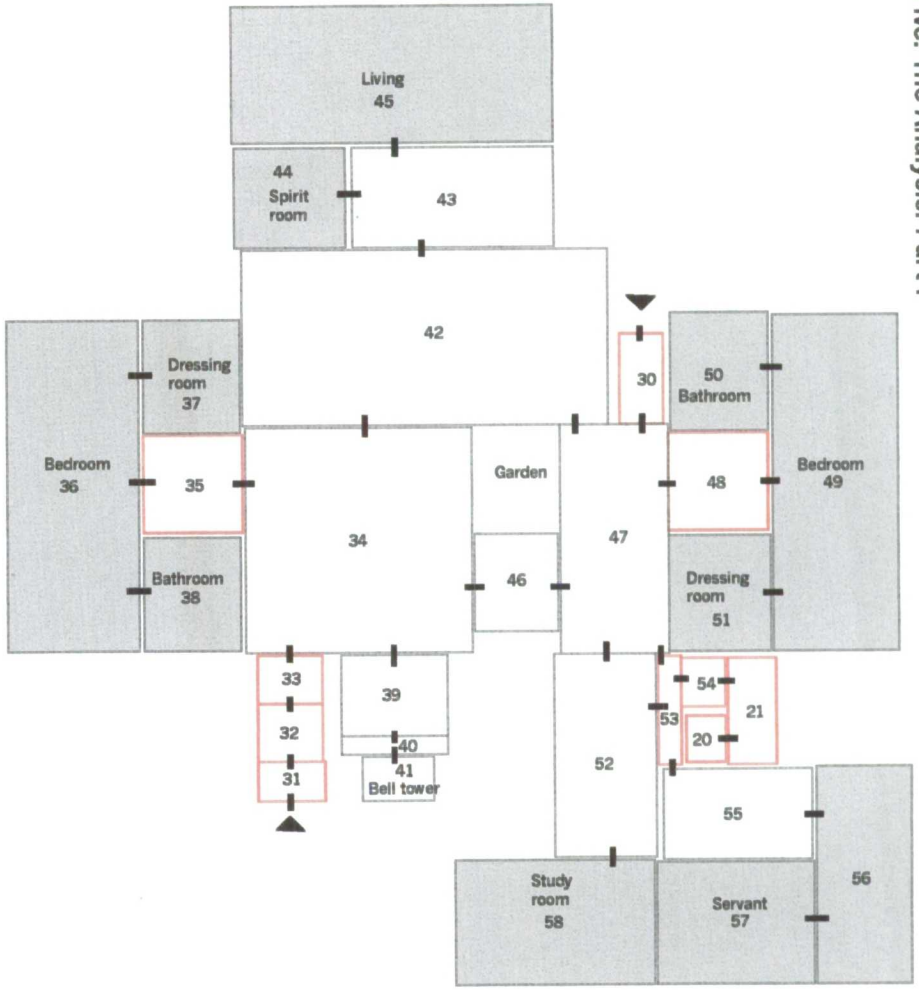
Figure 5.6 House 4 Convex space analysis

House 5 has conventional character but contemporary design (Figure 5.7). Similar to house 4, this house has expanded around its *chan* space which influenced the expansion around the courtyard on the ground floor. There are 29 convex spaces on both floors which are experientially connected through the open well over the garden in the courtyard. The house has the second largest proportion of enclosed space among the selected houses (36%) with an average proportion of open space (40%). The extension at the front of the house (spaces 55-58) was easily added without interfering with the original organisation of space. The convex organisation in house 5 is oriented toward the axes aligned with its three sets of stairs. The front stair serves only the first floor while the back stairs (space 30) connect two floors and establish a new axis with the service stairs (spaces 20, 21 and 54) which serve the new extension and define the service zone. Similar to that of house 4, house 5's service zone is isolated from other parts. This concept is very different from the conventional houses where service parts are closely incorporated into the whole configuration.

House 6 is the smallest and the most compact house in the research but it can accommodate as many monks as in house 3 (Figure 5.8). House 6 is a highly symmetrical design. *Chan* space is central to the convex organisation of the house. This monks' residence can be connected to others in the block through the extension of *chan* space in each module, e.g. spaces 18 and 19. Unlike house 3, the prayer hall is in the abbot's unit The house has only 30% of open space and the smallest proportion of connecting space (17%) suggesting its largest proportion of enclosed space among the selected houses (53%). There are strong axes in house 6 design; two circulation axes starting at spaces 1 and 2 which are linked by the axis through the common area (spaces 9, 10 and 11). There is a symbolic axis that connects the abbot's unit (and the prayer hall) to the dining hall where all monks assemble. This compact organisation is typical among contemporary monk houses in Thailand. This concept of Thai house design is the opposite of the extension concept used in houses 4 and 5.



Ground floor



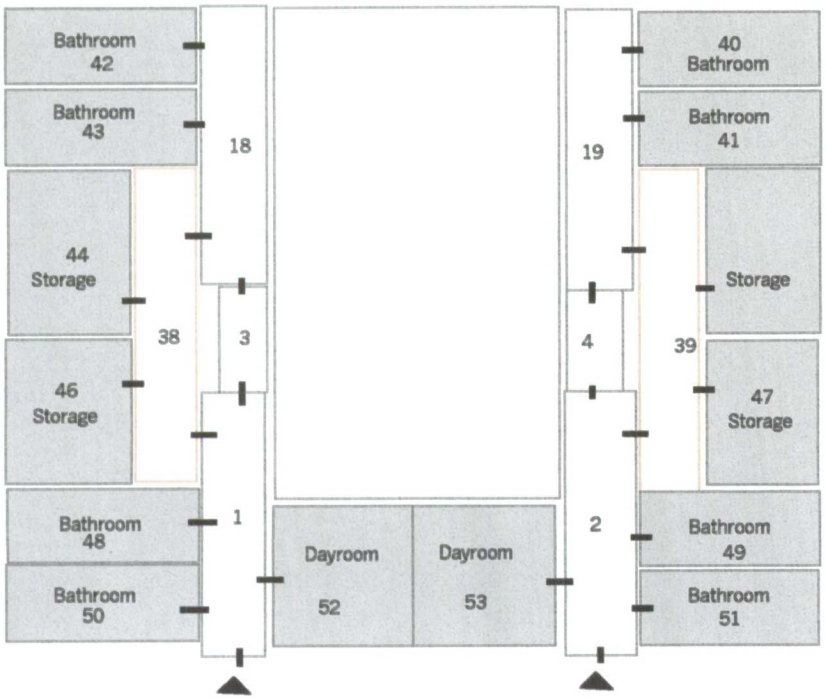
First floor

N

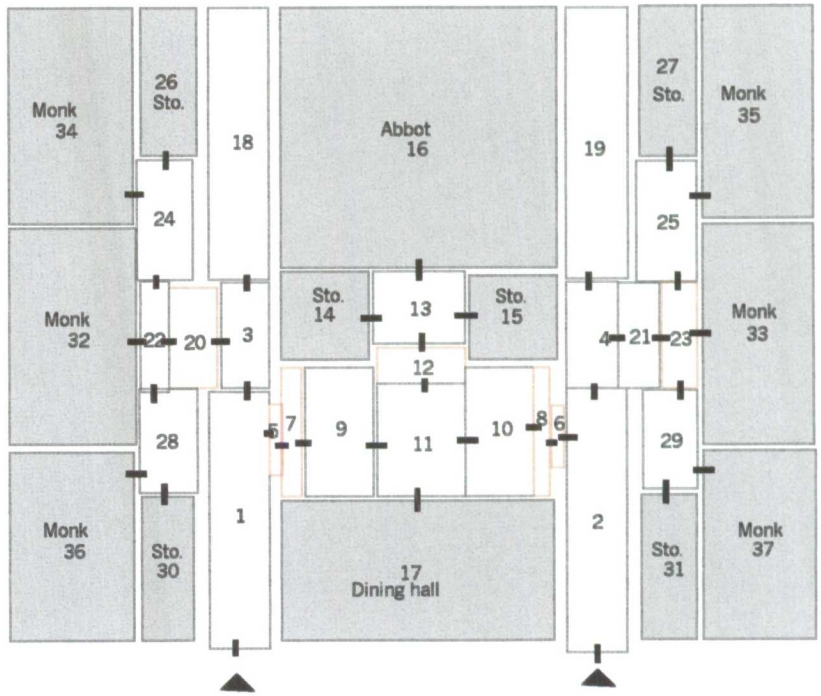
Access to ground

Open space Connecting space Enclosed space

Figure 5.7 House 5 Convex space analysis



Ground floor



First floor

N

Access to ground

□ Open space □ Connecting space ■ Enclosed space

Figure 5.8 House 6 Convex space analysis

In conclusion, symmetrical and asymmetrical designs are strong issues in the selected conventional houses where the major axes in the configurations are clear. On the other hand, contemporary houses create more convex spaces resulting in more axes of equal importance (Figure 5.9). This leads to issues of zoning and orientation of the houses which are achieved by the strategic organisation of key spaces on *chan*. The designs are clear in the selected conventional houses but ambiguous in the contemporary ones due to their complexity. On average, 42% are open spaces; 31% are enclosed and 27% are connecting spaces reflecting the spacious characteristic in the selected Thai houses. However, the spaces of the selected contemporary houses are more enclosed and seem to be more abrupt (fewer connecting spaces) than the spaces of the conventional ones (Table 5.1). Therefore, the complex organisation of convex spaces could suggest either a high or low degree of expansion while simplicity seems to suggest only a high expansive potential and flexibility. Investigations in the issues of symmetrical and asymmetrical design, zoning and orientation of *chan* space provide background for its structural dimension. The issues of expansion and compactness and simplicity and complexity relate to the experiential dimension while conventional and contemporary issues relate to functions and architectural elements.

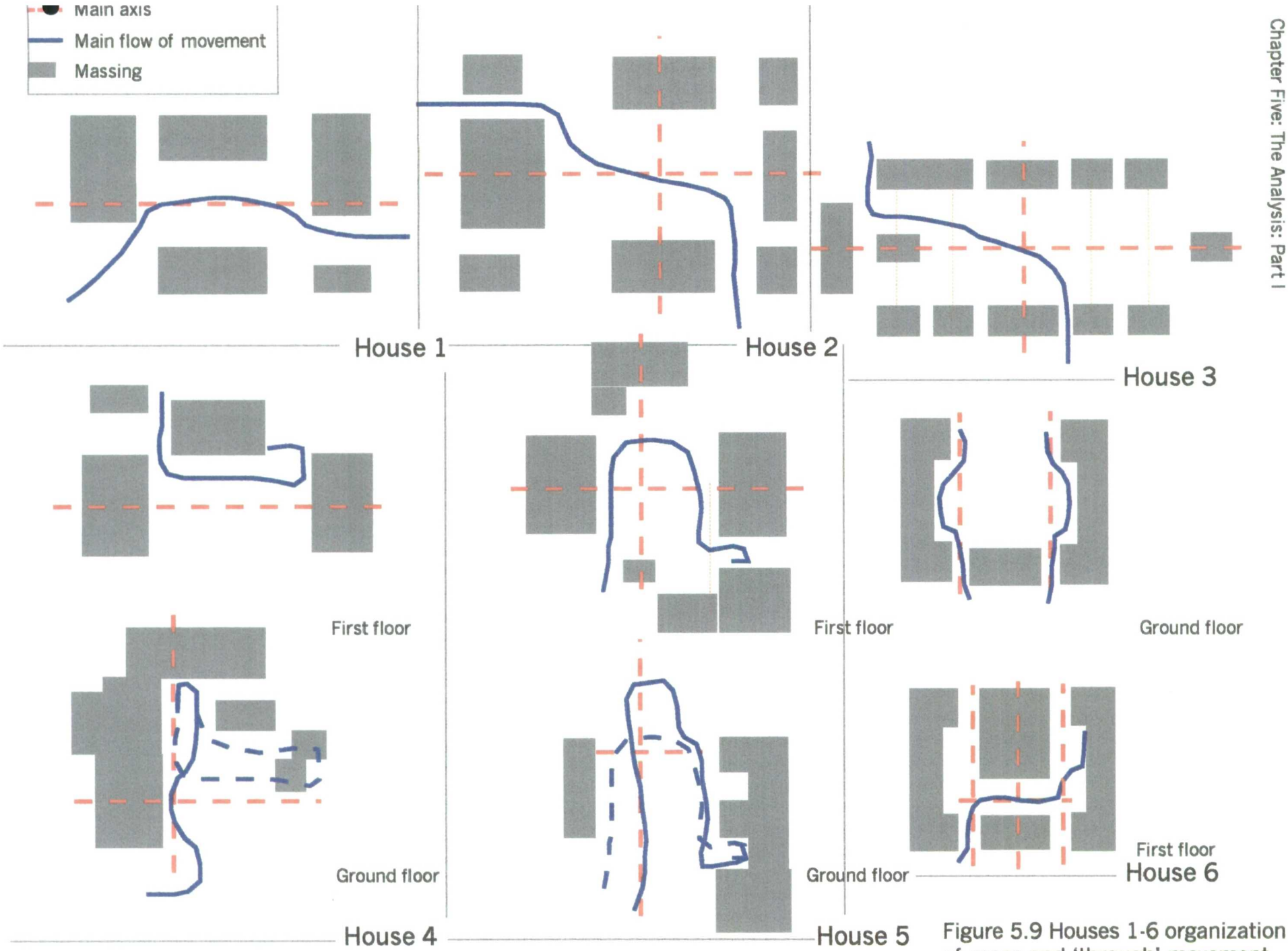


Figure 5.9 Houses 1-6 organization of mass and 'through' movement

Convex space analysis of the selected Thai temples

Thai temple designs originated from the concept of the Hindu's universe (Kalayanamitr, 1982) and *mandala*. The *ubosot* or the ordination hall is usually raised on a series of terraces and is the highest point in a temple which is clearly defined from the rest of the monastery by cloisters, gateways (temples 1, 2 and 3) and raised terraces (temples 4, 5 and 6). Temples' spaces are strictly controlled by means of many small junction spaces used as demarcations around the temple's periphery. The space beyond these spaces is seen as exterior space which is usually the open space in the monastery yard.

A temple's design does not have the flexible and expansive characters of a Thai house. The designs are mostly strictly laid out plans which are oriented around one main east-west axis. However, it was not a conscious architectural design process in a modern sense that generated the original concept of a Thai temple. The architects were never recognised; only the craftsmen who finished the buildings under the supervision of some authorities were credited. In most conventional temples, the convex spaces are organised according to the so-called 'divine proportion', or *mandala*, in plan and section. It is only recently that the design process of a temple has been formally realised by architects and sometimes in collaboration with the abbots of the temples. Through this process, Thai temple designs become more specific to the philosophy and needs of each temple.

However, there are many common themes that create similar spatial configurations since most designs are based on the same principles of traditional temple designs such as the extensive use of terraces. Like the *chan* space in the Thai house, terrace space is used in many possibilities combined with others such as cloisters, pavilions, prayer halls, and courtyards. Terrace space is usually simple and very well connected to every part of the temple. In conventional designs, terraces are normally connected to cloister and courtyard to create a complete sequence which becomes much simpler in contemporary designs where terrace are the sole dominating element. In both cases, the open space of a temple, mostly terraces, contribute around 60% of the whole space (Table 5.2).

The conventional Thai temples:

Temple 1 is the most concentric design of all the selected temples (Figure 5.10). The spatial configuration is in absolute symmetry on both east-west and north-south axes with the Buddha image just slightly off the centre, space 734, where worshippers kneel down and pray in front of the Buddha image. Temple 1 consists of two systems of convex space: the flow of open space on the terraces and the fragment of the transitional space in the cloisters portraying the successive systems of open and enclosed spaces toward the *ubosot*. This Thai-Buddhist connotation of wave-like configuration was used in its complete form in this temple.

There are 743 convex spaces in the temple; some are defined by activities more strongly than the physical settings such as the prayer hall space in four directional *wihans* (spaces 18, 33, 238, 253, 262, 277, 484 and 499). The spaces are transformed by activities into invisible cubes with walls on three sides and another convex cube, created from the prayer platform and the altar, on the fourth side. This characteristic is common in Thai architecture where fewer boundaries are used to define an area. Instead, it is the custom rules in experience that differentiate spaces. The convex map of the temple is very complex and full of small fragmented spaces that, however, are put in a symmetrical system. There are some adaptations of the original design such as three new seating areas on the lower terrace which are separated from the terrace space by rows of columns and the roof line (spaces 521, 546, and 556). Windows and doorways are specially treated and have independent volume because of their architectural and socio-cultural significance.

There are small pocket spaces that are created by very thick columns (0.80 by 0.80 metre) on the upper terrace and by *Semas* (demarcation posts) and gateways on the lower terrace. 119 convex spaces are in the *ubosot*, 23-25 convex spaces in each of the four directional halls, the *wihan thits*, and 6-7 convex spaces in each of the eight courtyards. 107 convex spaces are in the lower and inner terraces. 367 convex spaces are in the inner and outer cloisters, gateway, and stairs. In conclusion, the cloister, gateways and stairs contain the largest proportion of convex spaces (49%) followed by the *ubosot* (16%) and the terraces (14%). The temple has the most contrast proportion of open and enclosed spaces (76% in contrast to 7%) resulting in its smallest proportion of connecting spaces (17%).

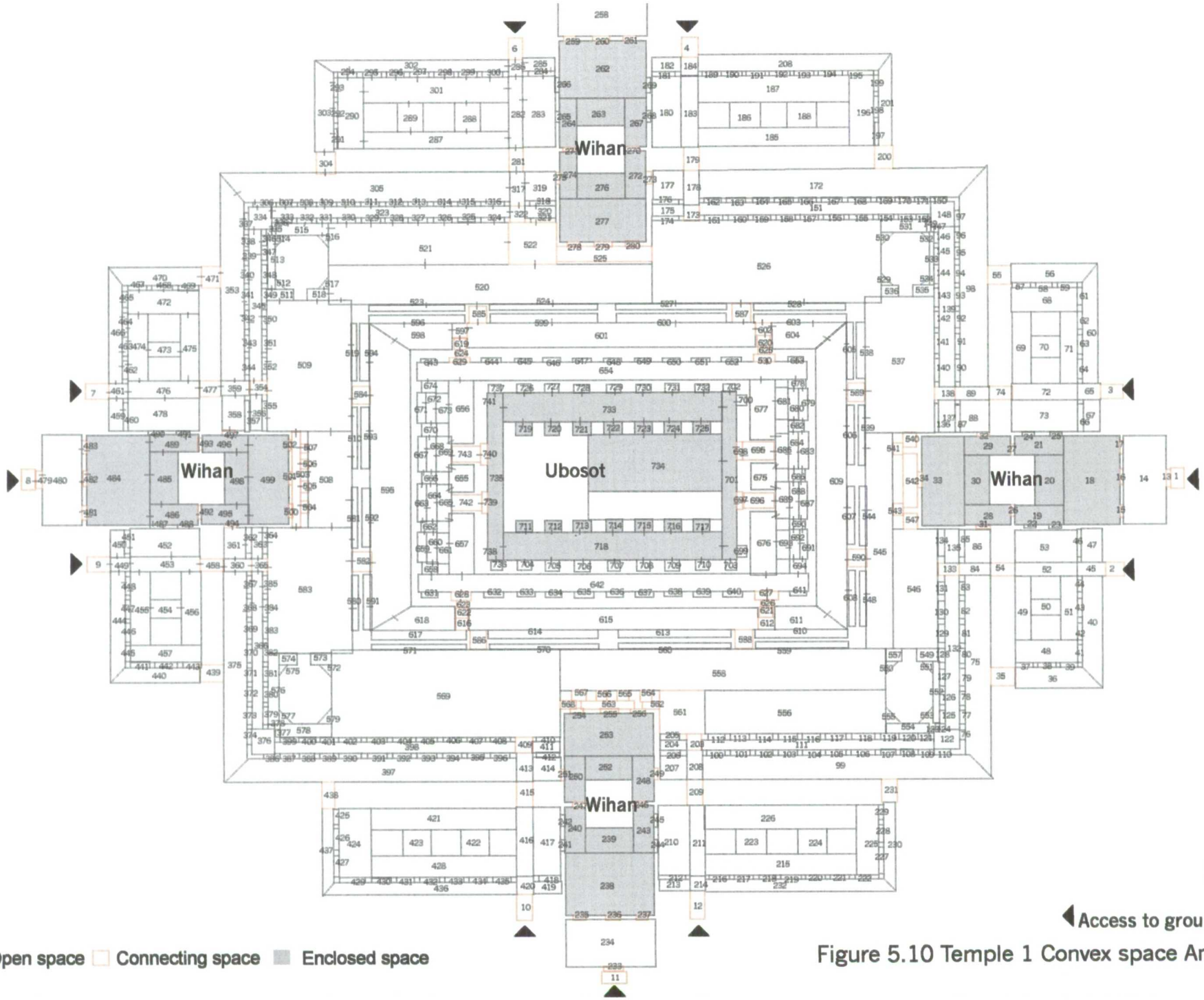
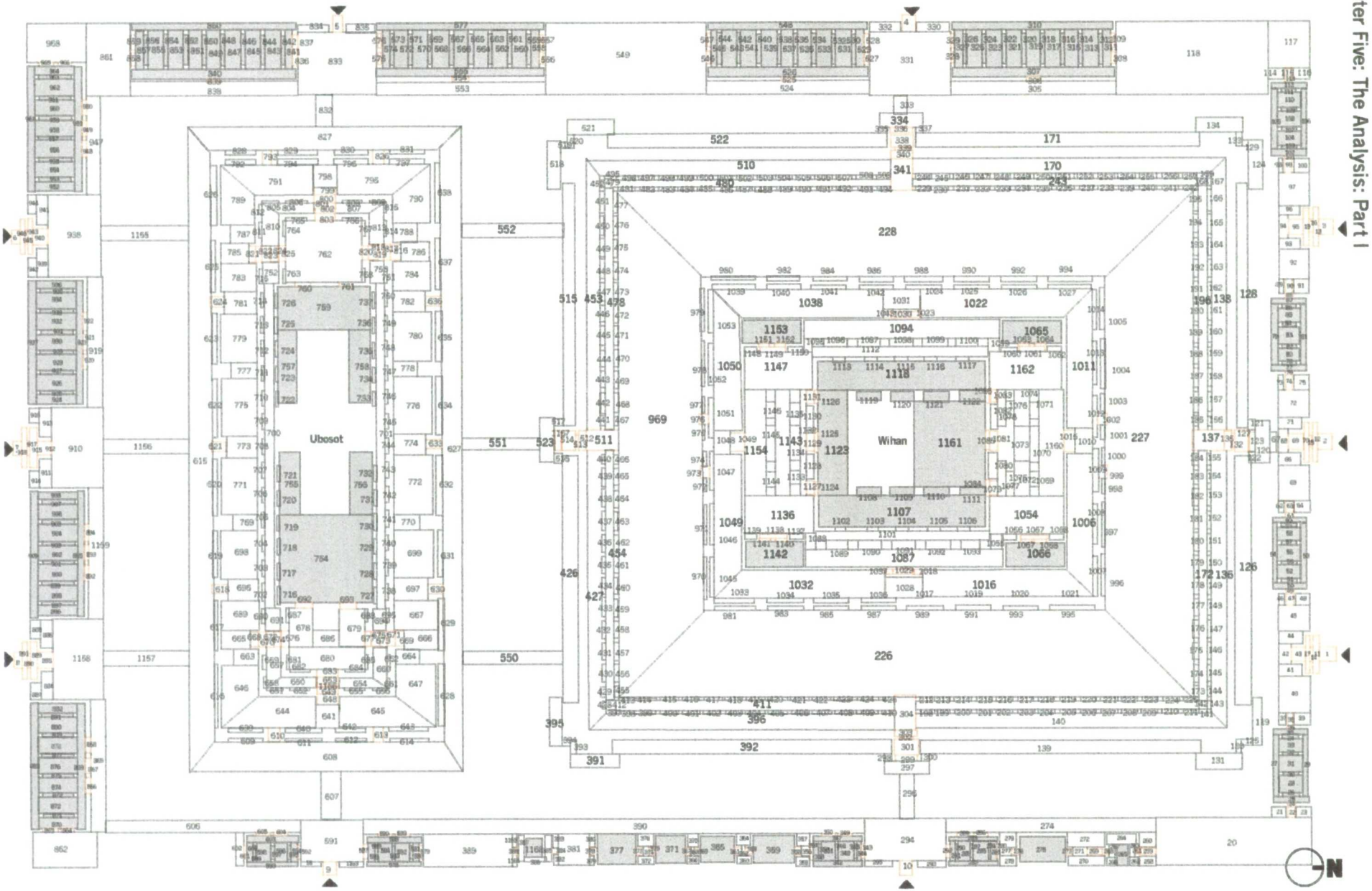


Figure 5.10 Temple 1 Convex space Analysis

Temple 2 is one of the largest temples in Thailand (Figure 5.11). All the main convex spaces in the *ubosot*, and the *wihan* are oriented on the east-west axis. The *wihan* is at the centre surrounded by the cloisters with successive wave-like concept as in temple 1. A north-south axis is used to achieve a more flexible design in this temple. The *ubosot* spaces are symmetrically organised around this north-south axis while maintaining relations with the *wihan* spaces on the east-west axis. The temple therefore has two loci that are dynamically related to each other and yet manage to exist independently. Of all 1168 convex spaces, the most distinctive in terms of locations and experiences are the lower terraces around the *wihan* with clean and sharp profile (spaces 226, 227, 228 and 969). Balustrades and gateways on the *wihan* terraces create small pocket spaces while at the *ubosot*, the terrace spaces (e.g. spaces 696-788) are rhythmically divided by rows of big gateways, monuments and *sema* posts (around 1.50 by 1.50 metres). This design creates the effect of a series of rooms rather than long corridors.

Similar to the unit system design of Thai houses, the pavilions around the temple's perimeter are conceived as systems of rooms in two, three, five and seven-bay types. These pavilions are located by the gateways and alongside the walkways in the temple's courtyard. The courtyard surrounding the *ubosot* and *wihan* complex can only be accessed using the walkway system that was designed around the four cardinal axes. 434 convex spaces in the *wihan* complex and 200 convex spaces in the *ubosot* complex represent 54% of the temple spaces. Temple 2 has the highest proportion of enclosed space of all the selected temples (22%) with the second lowest proportion of open space (59%).

Temple 3 is the smallest of all the selected temples. The temple is symmetrically organised around the east-west axis emphasised by a small courtyard with two *chedis* on the east side (Figure 5.12). The east entrance is originally the main entrance for religious ceremonies however, in practice the south side entrance is the most common way to enter the temple. This temple has no strong successive wave-like configuration because the *ubosot* is heavily oriented on the east-west axis. The design of the cloister, however, acknowledges the north-south axis as two entrances are located on this axis. The intersection of these major and minor axes is at the prayer hall (space 105) which has no windows and thus it is completely isolated from other spaces in the temple.



Open space Connecting space Enclosed space

Figure 5.11 Temple 2 Convex space analysis

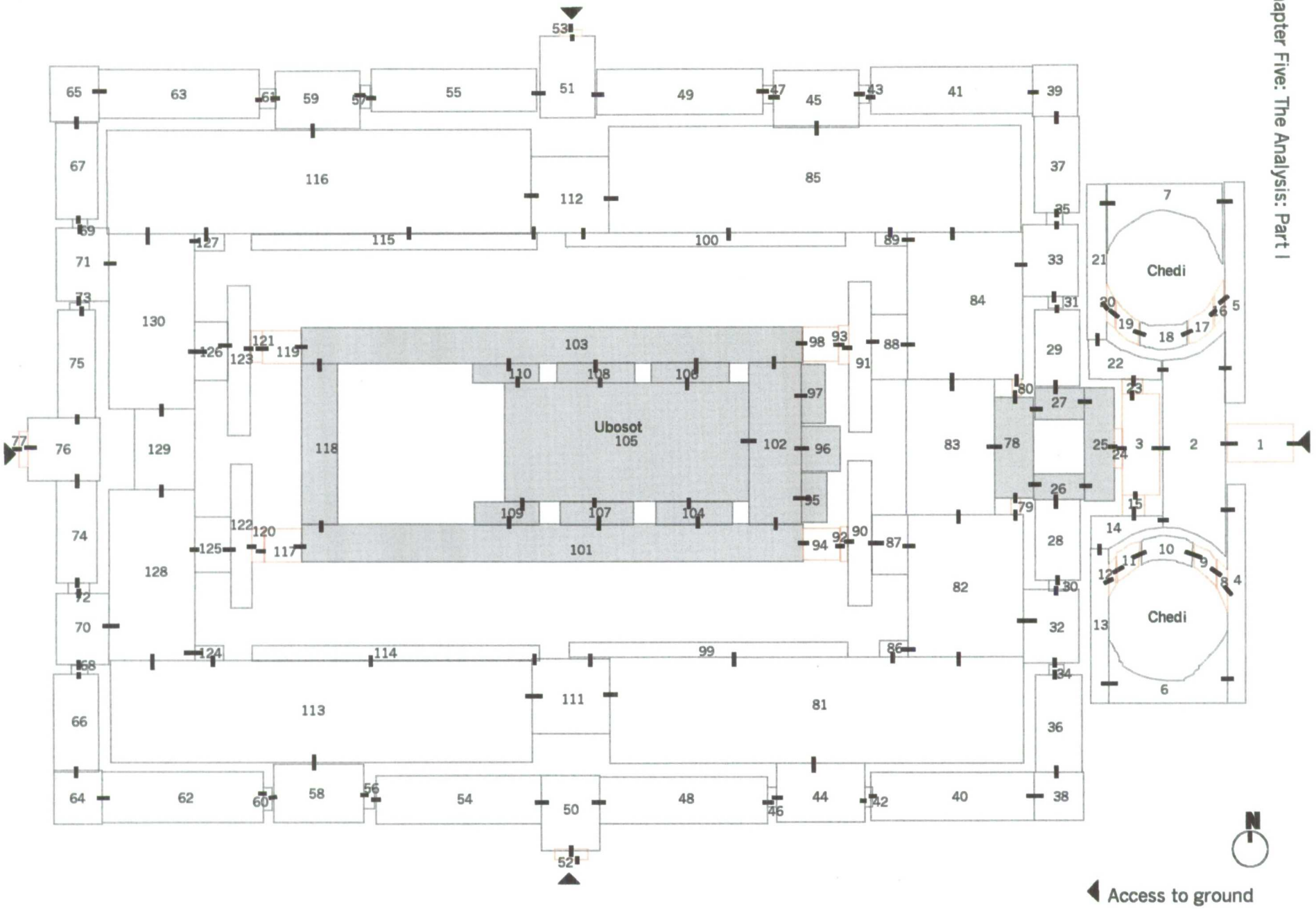
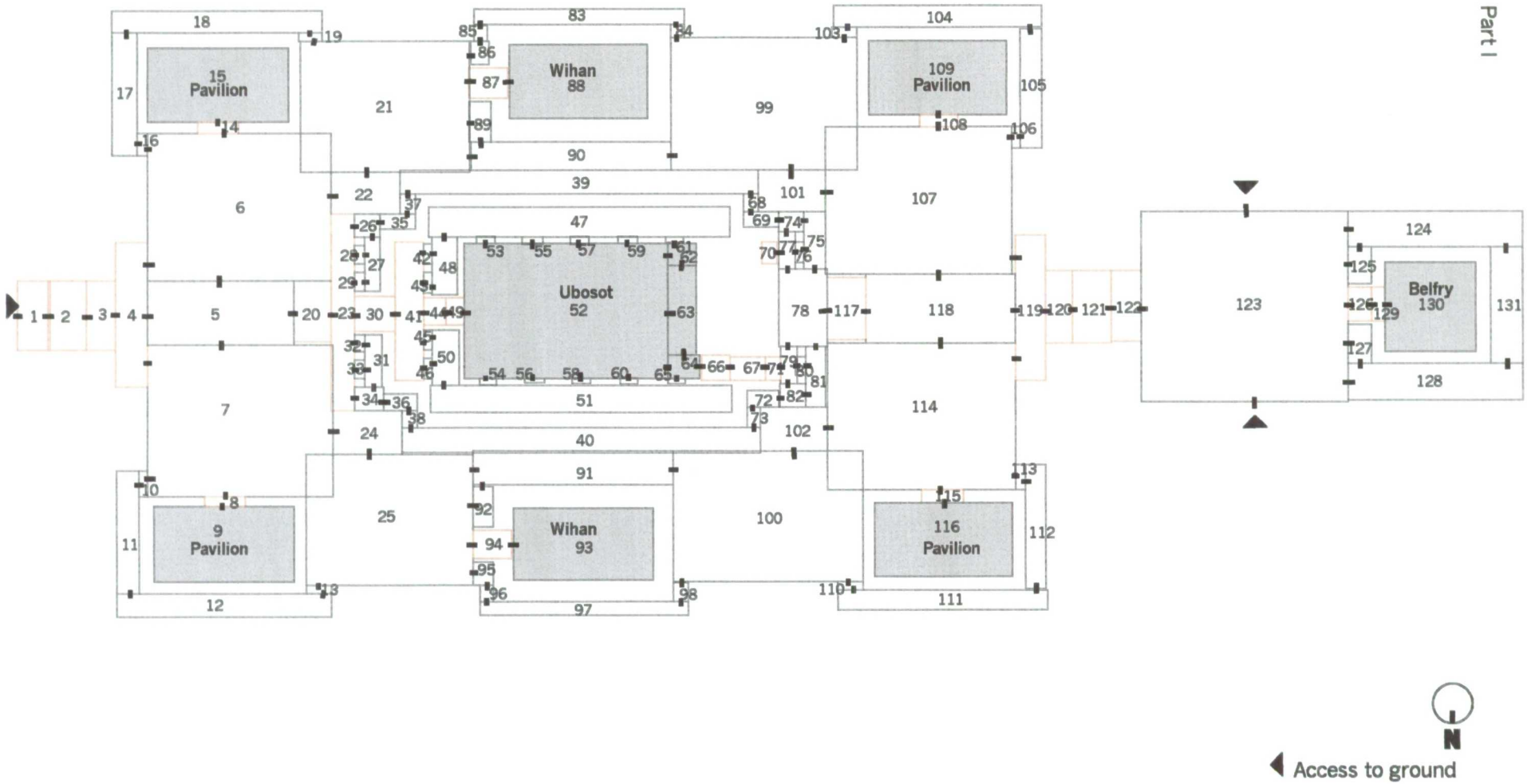


Figure 5.12 Temple 3 Convex space analysis

Temple 3's terraces are simple but cut into four sections by the two major cardinal axes which are emphasised by the gateways in the cloister. Terrace and cloister spaces do not flow freely from one to the other but are constructed as connecting rooms joined together by a few openings. As a result the cloister assumes an independent spatial configuration and becomes a building in its own right. This suggests the dynamic design that involves two or more systems in one spatial configuration. Temple 3 has 130 convex spaces in total, 21 convex spaces make up the *ubosot*, 24 are terrace spaces and 50 are cloister spaces. Its 67% open space, 14% enclosed space and 20% connecting space are among the largest proportions in the selected temples (Table 5.2). The spatial configuration of this conventional temple is simple and the scale of convex space is closer to the human scale than in any other selected temples. This design creates simple orientation in the temple's space despite the absence of window spaces which one can see through the *ubosot* to orient oneself with the other side. There are very few residual spaces in the configuration which suggests the simple and yet authentic temple design.

The contemporary Thai temples:

Temple 4's design was conceived by both the abbot and architect. According to the abbot, simplicity was the initial concept behind the temple's design and architectural features (Figure 5.13). It is raised on one big terrace higher than the usual height of a Thai temple. This lessens the need for another enclosed system such as cloister making the complex less complicated and more accessible. The temple is symmetrically oriented on east-west axis. Even though there are six other buildings aligned on the north-south axis, they are merely sequential elements that enhance the direction of the main axis. Similar to Thai house designs, these pavilions and detached units are organised on one big terrace. These units (spaces 9, 15, 88, 93, 109 and 116) are clearly visible but are accessible only through small convex spaces. This character of contemporary design shows the increasing proximity between terrace space and the sacred area of *wihan* and *ubosot*. The prayer hall (space 52) can be easily accessed from the main terrace in only a few steps. The connection between the *ubosot* and the exterior space is also short and straightforward from the front and back entrances.



Open space Connecting space Enclosed space

Figure 5.13 Temple 4 Convex space analysis

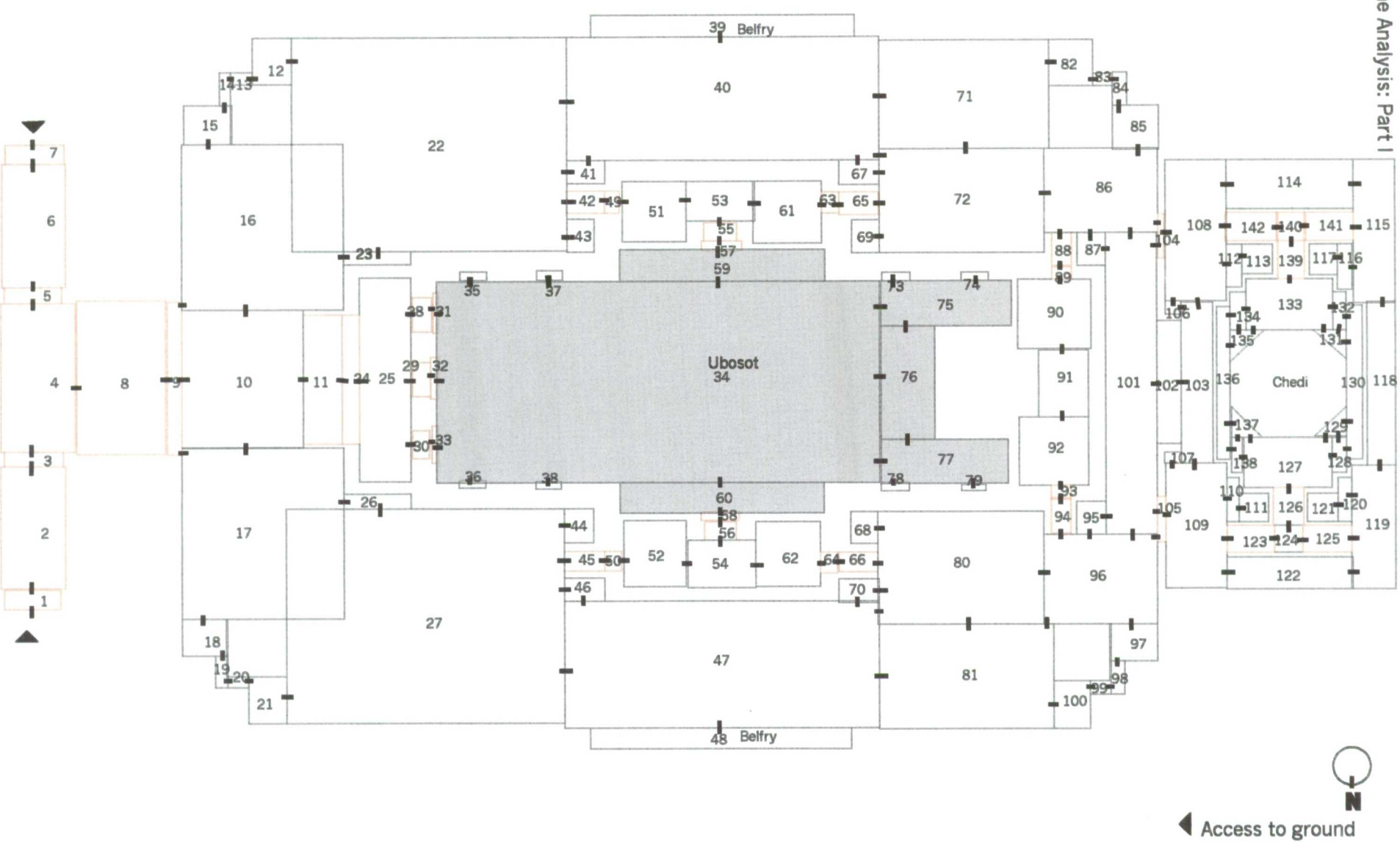
Temple 5 has an impression of a conventional Thai temple. The design was the collaboration between the abbot who preferred a certain style and the architect who fitted in all the required elements. The design responds to contemporary activities and the limitation of space. The temple is raised to the second-floor level to make room for other functions on the ground level. With this limitation, the enclosed space in the *ubosot* is organised to be as accessible as possible from the exterior space. In this respect, there is a contrasting concept in temple design wherein the conventional design the *ubosot* would be strongly restricted from outside in many ways rather than be encouraged as in this temple. The temple is oriented around the east-west axis as in most temples with a minor axis placed on two small upper terraces connected to the side entrances of the *ubosot* (Figure 5.14). At the time of observation (February – June 1999), a *chedi* complex with two levels of terrace was being added to the complex. Other elements are four pavilions and two belfries; their sizes are all reduced to a minimum and are placed in such a way as to emphasise the temple's open space.

Of all 142 convex spaces in this temple, only 6 are enclosed spaces, the least of all the selected temples (4%). However, temple 5 has the second highest percentage of connecting spaces (30%) but its enclosed spaces are dominant in size and location making the temple's *ubosot* highly accessible from open space on the terrace. The prayer hall is the only space in the configuration that is not compact but seems to be elongated along the terrace because of the need to accommodate all the monks of the monastery and to attract as many worshippers as possible. Convex spaces on the terrace are reduced to fragments which is the result of trying to fit many features into a complex.

Temple 6 is one of the latest contemporary designs which is again an interpretation by both the abbot and the architect to convey the minimalism. As usual the east-west axis is the main axis for the whole configuration (Figure 5.15). The temple is extremely simplified where big convex spaces on the terrace do not have many adjacent spaces. Contemporary temples seem to share the common characteristics of simplicity and compactness which means their enclosed spaces are more open and highly accessible from outside. Temple 6 has one main entrance on the east-west axis and two sub-entrances on the north-south axis which are more emphasised than those in other temples. Temple 6 has the cross-plan *ubosot* which is quite unusual for a Thai temple but

is increasingly popular in the new temples (e.g. the Buddhapadipa temple in London). This design also creates a cross shape terrace.

Temple 6 comprises only the *ubosot* and terrace. It has only four enclosed convex spaces with the lowest proportion of open space in selected temples (14%) but the largest proportion of connecting space (49%). It is interesting that in contemporary Thai temples the designs can afford compactness and simplicity in many parts but not in those of transitional spaces. Every temple except temple 2 has a much larger proportion of connecting spaces compared to that of enclosed spaces (Table 5.2). Finally, despite its simplicity, the *ubosot* space in temple 6 is not as simple as those in temples 4 and 5 because its enclosed space is oriented on two axes rather than one. This effect emphasises the interior space of the temple, the design strategy of indoor/outdoor and the flexible idea of sacredness.



Open space Connecting space Enclosed space

Figure 5.14 Temple 5 Convex space analysis

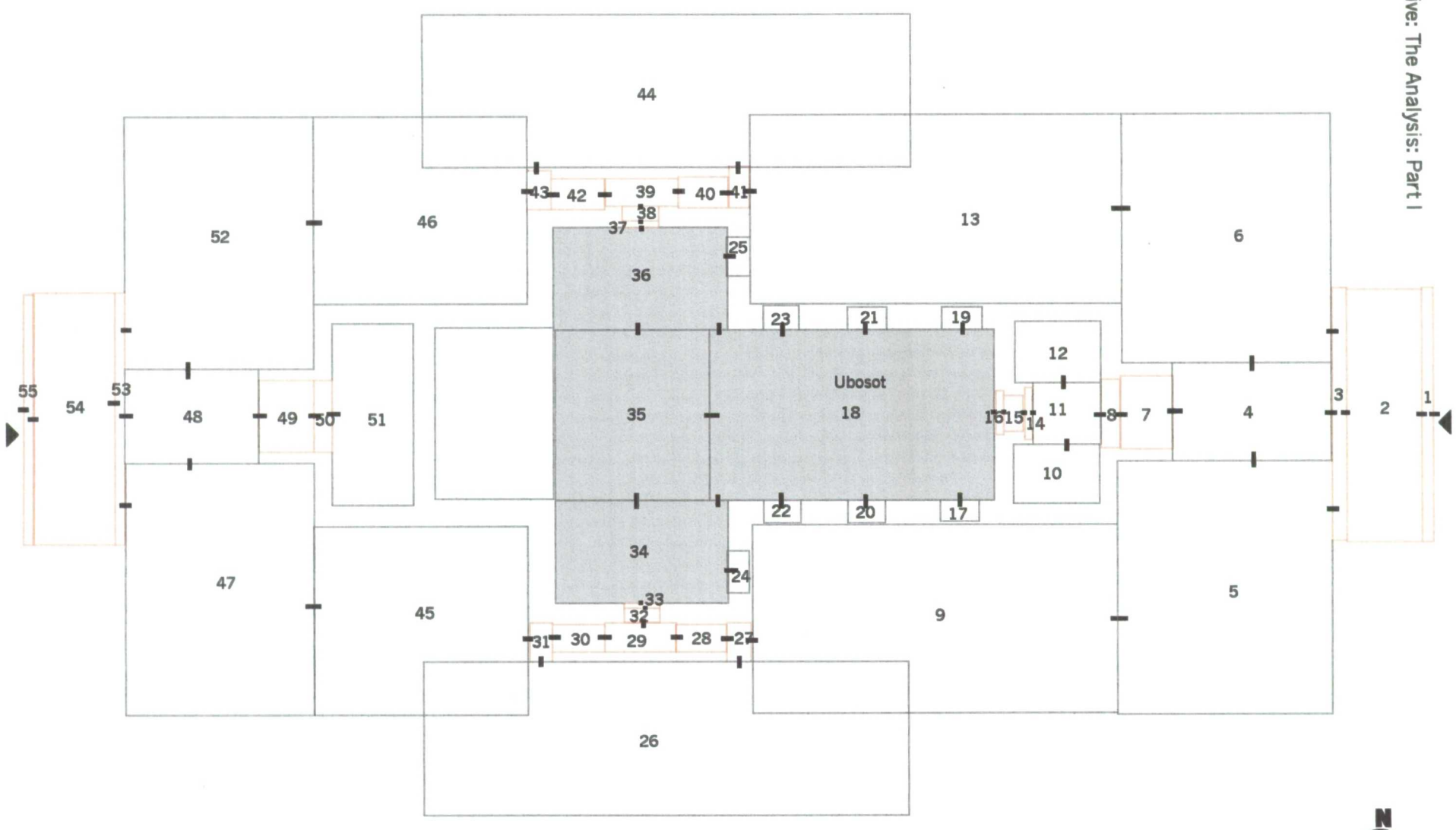


Figure 5.15 Temple 6 Convex space analysis

In conclusion, apart from the cardinal points-based rule of *mandala*, there are issues of major and minor axes, the use of terrace space and the locations of architectural features and entrances that shape the overall spatial configurations of a Thai temple (Figure 5.16). The centre of a temple is at the *ubosot* space which is usually the only enclosed space in a temple and the reference point for all other convex spaces. This characteristic is at its strongest in temple 1 where the *ubosot* is at the intersection of two main axes. Temple 2 is an exception where the *wihan* is the dominating centre. The *ubosot* is usually located on the main east-west axis and its length runs parallel to the axis. In temples 2 and 3, there are two systems where both axes are simultaneously emphasised to create the flexible organisation of convex spaces.

Temples 4, 5 and 6 are strongly oriented on the east-west axis making their convex spaces simpler than the two-axis system. The contemporary designs tend to be asymmetrical especially on terraces which are the most flexible space in a temple. Concepts such as simplicity, compactness or minimalism in the temple's open space seem to have great effects on its architectural features. For example, in temples 5 and 6, there are sub entrances that emphasise the north-south axis of the *ubosot* resulting in both temples having small upper terraces attached to their *ubosots*. On a bigger scale, the north-south axes in temples 1, 2 and 3, are emphasised by the cardinal entrances resulting in larger-scale linear shape terraces.

Of all 2369 convex spaces, the average proportion of open space (terrace, cloister and courtyard) from the selected temples is even higher than that of Thai houses (66 % compared to 42%). The proportion of connecting spaces, (e.g. doorway, gateway and stairs) is often larger than the enclosed spaces in both houses and temples indicating the high flexibility of architectural space in all dimensions. Both Thai houses and temples have the concept of using space as the major instrument in design rather than physical partitions. Thai designs are often symmetrical but not centralised and less rigid than westernised architecture (e.g. Palladian influences). These general characteristics of the selected examples provide the design background for further detailed analyses. In the next analysis, the selected buildings will be seen in their intrinsic qualities through the topological properties of their convex spaces.

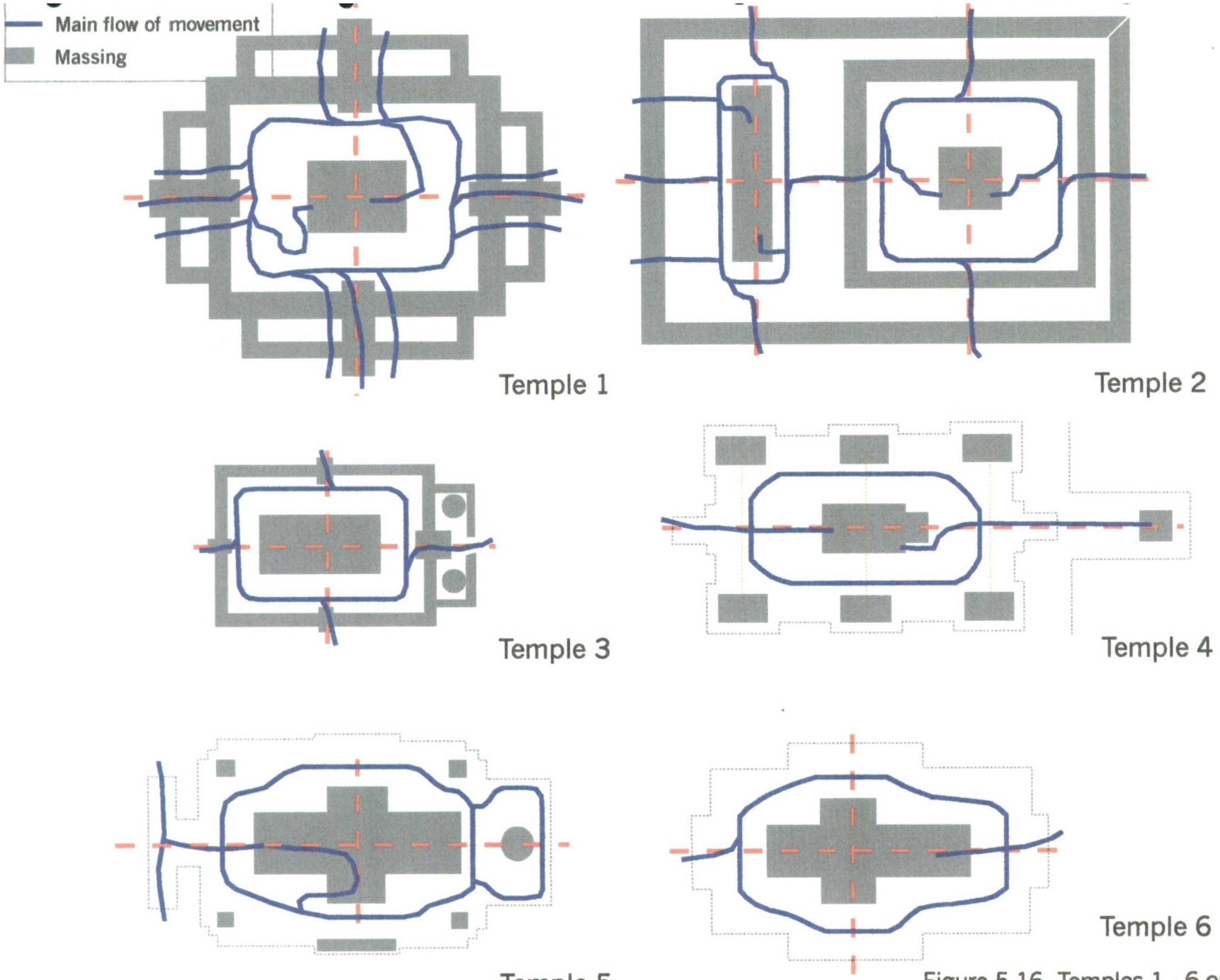


Figure 5.16 Temples 1 - 6 organization of mass and 'from-to' type of movement

5.2 Justified Graph analysis

Numerical data: Tables 5.3-5.6 (p.210-211)

Graphical data: Figures 5.17-5.48

The analysis uses a justified graph in order to discuss structural properties of a building's convex spaces, first as a whole and then as an individual or group of convex spaces. A justified graph is derived from a convex break-up map based on a building's architectural plan (Hillier, Hanson and Graham 1987). A justified graph has three components: nodes, lines and a root; it is a linear graph (Ore, 1963). A node represents one convex space that has physical connections with other convex spaces, nodes, around it. A physical connection, or connectivity, is represented in a justified graph by a line. The root of a justified graph represents exterior space from where the space inside a building branches out usually at the bottom of the graph or at level 0.

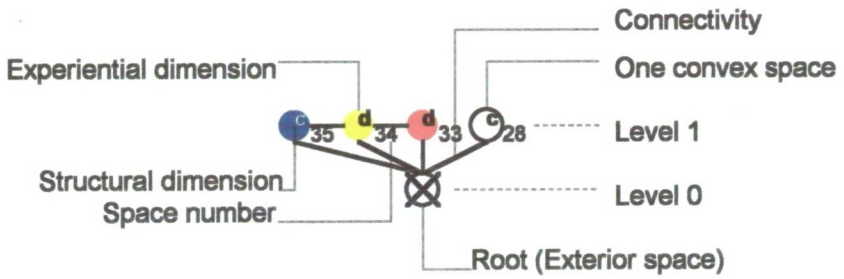


Figure 5.17. Components of a dual dimension justified graph

The aspects of depth, connectivity, permeability, distribution, and sub-complex of space in a building are made clear in the form of justified graphs. In order to arrive at these aspects of space as a whole or of a single convex space, Thai houses and temples are seen as spatial structures deduced from the convex space analysis of their plans (Figures 4.15-4.20 and 4.33-4.38). According to location and connectivity, Hillier (1996) categorises convex spaces into four types: a-(dead end), b-(two connections or more not in a ring), c-(two connections or more in a ring) and d-(three connections or more in at least two rings). These properties of space represent the structural dimension of architectural space. They are labelled alongside every node in the justified graphs of the selected houses and temples. Furthermore, a convex space or a node in a graph will be identified with its experiential dimension based on bodily movement in architectural space into three types: passage, junction and place type spaces (Suvanajata, 1994).

Traditional Thai houses: **Houses 1 – 6**: Structure						
Type	H 1 (35): number of space (%)	H 2 (42)	H 3 (61)	H 4 (91)	H 5 (58)	H 6 (53)
a	5 (14.3)	9 (21.4)	18 (29.5)	11 (12.1)	**18** (31)	**28** (52.8)
b	3 (8.6)	10 (23.8)	2 (3.3)	7 (7.7)	11 (18.9)	10 (18.9)
c	**21** (60)	**15** (35.7)	16 (26.2)	26 (28.6)	15 (25.9)	13 (24.5)
d	6 (17.1)	8 (19.1)	**25** (40.9)	**47** (51.6)	14 (24.1)	2 (3.8)
Total type: 4	4	4	4	4	4	4
Total space = **340** + 6 exterior spaces						

Table 5.3. Structural dimension of Houses 1-6

Traditional Thai houses: **Houses 1 – 6**: Experience						
Type	H 1 (35): number of space (%)	H 2 (42)	H 3 (61)	H 4 (91)	H 5 (58)	H 6 (53)
passage	8 (22.9)	12 (28.6)	14 (22.9)	25 (27.5)	16 (27.6)	13 (24.5)
junction	**14** (40)	**18** (42.9)	22 (36.1)	31 (34.1)	13 (22.4)	12 (22.6)
place	13 (37.1)	12 (28.6)	**25** (40.9)	**35** (38.5)	**29** (50)	**28** (52.8)
Total type: 3	3	3	3	3	3	3
Total space = **340** + 6 exterior spaces						

Table 5.4. Experiential dimension of Houses 1-6

Traditional Thai temples: **Temples 1 – 6**: Structure						
Type	T 1 (743): number of space (%)	T 2 (1168)	T 3 (130)	T 4 (131)	T 5 (142)	T 6 (55)
a	101 (13.6)	227 (19.4)	3 (2.3)	19 (14.5)	18 (12.7)	11 (20)
b	-	11 (0.9)	-	8 (6.1)	5 (3.5)	2 (3.6)
c	**402** (54.1)	**655** (56.1)	**89** (68.5)	**71** (54.2)	**78** (54.9)	18 (32.7)
d	240 (32.3)	275 (23.5)	38 (29.2)	33 (25.2)	41 (28.9)	**24** (43.6)
Total type: 4	3	4	3	4	4	4
Total space = **2369** + 6 exterior spaces						

Table 5.5. Structural dimension of Temples 1-6

Traditional Thai temples: **Temples 1 – 6**: Experience						
Type	T 1 (743): number of space (%)	T 2 (1168)	T 3 (130)	T 4 (131)	T 5 (142)	T 6 (55)
passage	197 (26.5)	243 (20.8)	53 (40.7)	53 (40.5)	**68** (47.9)	22 (40)
junction	**506** (68.1)	**744** (63.7)	**73** (56.2)	**68** (51.9)	64 (45.1)	**28** (50.9)
place	40 (5.5)	181 (15.5)	4 (3.1)	10 (7.6)	10 (7)	5 (9.1)
Total type: 3	3	3	3	3	3	3
Total space = **2369** + 6 exterior spaces						

Table 5.6. Experiential dimension of Temples 1-6

Passage-type space gives the experience of 'to-and-from' movement in architectural space while junction-type gives the experience of 'in-between' movement and place-type gives the experience of 'in-a-space' movement such as corridor, doorway and room, respectively. Each node in a graph is given a different colour; blue is for passage, red for junction and yellow for place (Figure 5.17). The following analysis discusses the structural and experiential dimensions of the selected Thai houses and temples based on the information provided by the graph and on-site experiences. The relations between the two dimensions will be fully discussed as the conclusion in the theoretical analysis.

Justified graph analysis of the selected Thai houses

As a whole, a justified graph conveys basic information of an architectural plan; that is, it represents movement and permeability in space. The analysis looks at the general formation of a graph as well as focusing on certain convex spaces in the important parts of the selected buildings. The analysis will follow up on earlier emphases in the convex space analysis of houses i.e. issues of symmetrical and asymmetrical structure, zoning and orientation of *chan* spaces and issues of expansion and compactness. The analysis aims at explaining the abstract properties of a spatial configuration and starting to see them in the real locations and situations.

The conventional Thai houses:

According to its graph, house 1's structure is quite simple. It has the least number of convex spaces and the least number of links in its graph (Figure 5.18). The house structure is divided into three parts: the living units at the front, the sleeping units at the middle and the service sector at the back part of the house. c-type spaces represent more than half of all convex spaces in house 1's structure. These spaces (e.g. spaces 10 and 14 or spaces 9, 8 and 19) usually create segregation between sleeping units and the rest of the structure (Figure 5.19). This design makes house 1 comparatively deep in real experience despite its low ratio of number of links to number of spaces (SLR=1.222).

The most expansive level of the graph is at level four where c-type spaces dominate. c-type space is also the most widely distributed type that appears in every level of the graph. As observed earlier, spaces 7, 9 and 20 seem to be important ones in the house's convex space organisation linking the three main zones of the house's structure together.

They suggest the potential of expansion, as they are all passage-type space. It seems that c-type space (e.g. space 9) is internally in control while d-type space (e.g. spaces 7 and 20) is in control of the expansion of the structure.

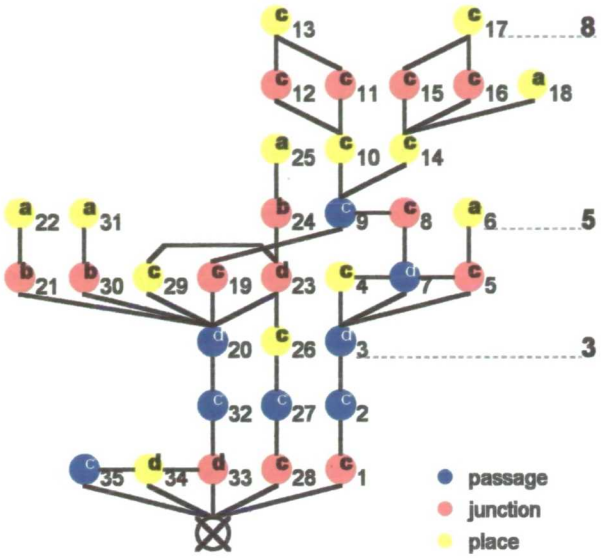


Figure 5.18. Justified graph of house 1
Total space = 35 + 1 ext. and 43 links, Space-Link Ratio = 1.222

The dominant experiences of house 1 are junction and place (in 13 and 14 spaces, respectively). Junction-type space dominates the real experience of the house because of the strong emphasis of doorways and steps throughout the house. Walking around the house gives the impression of strong spatial control in this open-plan structure. Appearing on 7 levels, the most widespread experience is place-type space as one might anticipate in house architecture. There are as many place-type as passage-type spaces in the *chan* space of this house. In fact, more than 30% of place-type spaces in house 1 are open spaces suggesting a flexible distribution of activities.

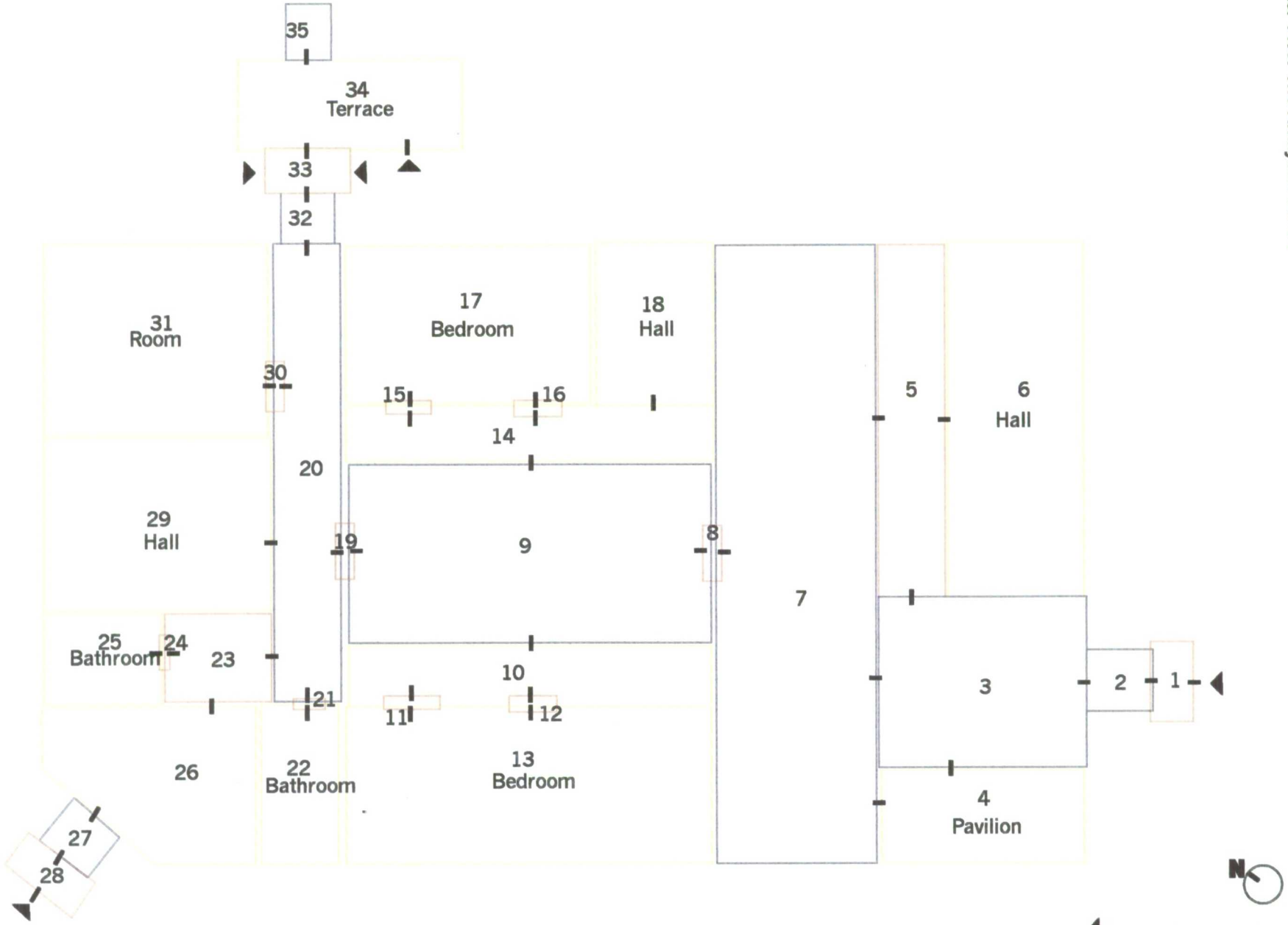


Figure 5.19 House 1 Convex space analysis

House 2's structure is more symmetrical than house 1's (Figure 5.20) and again dominated by c-type spaces. The house has the second highest integration value of all the selected houses (0.944) because a- and d-type spaces here have a relatively high integration value despite the high number of the segregating types, b- and c-type spaces. As in house 1, house 2's justified graph has eight levels but its structure is more ringy. The openness and a more complex local configuration of convex spaces in the house's open space make house 2 more internally integrated than house 1. A high degree of ringiness does not therefore always indicate a space heavily partitioned by physical boundaries but can also mean opening or straightforward symmetrical experience. This effect employs a subtle arrangement of space to differentiate and locate architectural elements (Figure 5.21).

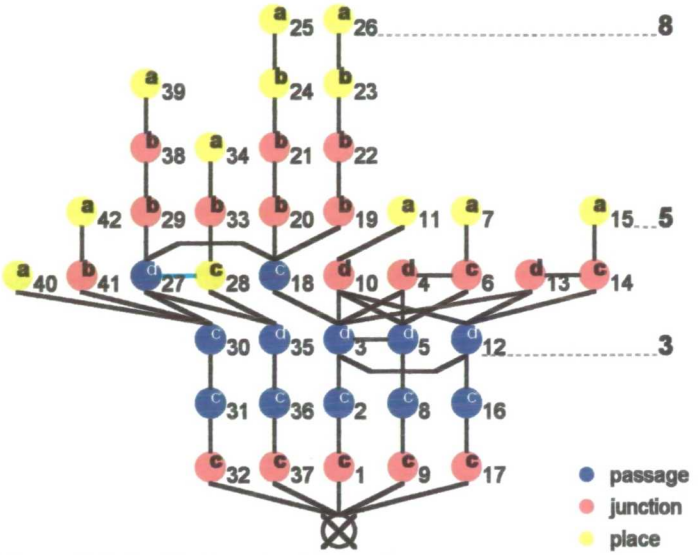


Figure 5.20. Justified graph of house 2
Total space = 42 + 1 ext. and 52 links, Space-Link Ratio = 1.233

The most expansive level in the graph is at level four with ten nodes (compared to eight nodes in house 1's). At this level, one can access many enclosed spaces (e.g. spaces 7, 11, 15 and 42) but never the sleeping units (spaces 23, 24 and 39). The most widespread space type on level four is d-type space, not c-type as in house 1. The key *chan* spaces are located on level three and four; spaces 3, 18 and 27 are at similar locations as those discussed in house 1. The difference is that space 18, c-type, is more integrated with the other two d-type spaces and thus play the role of the integrator more than the segregator. However, this space still provides sleeping units with privacy by being the only space between the sleeping complexes and the rest of the structure.

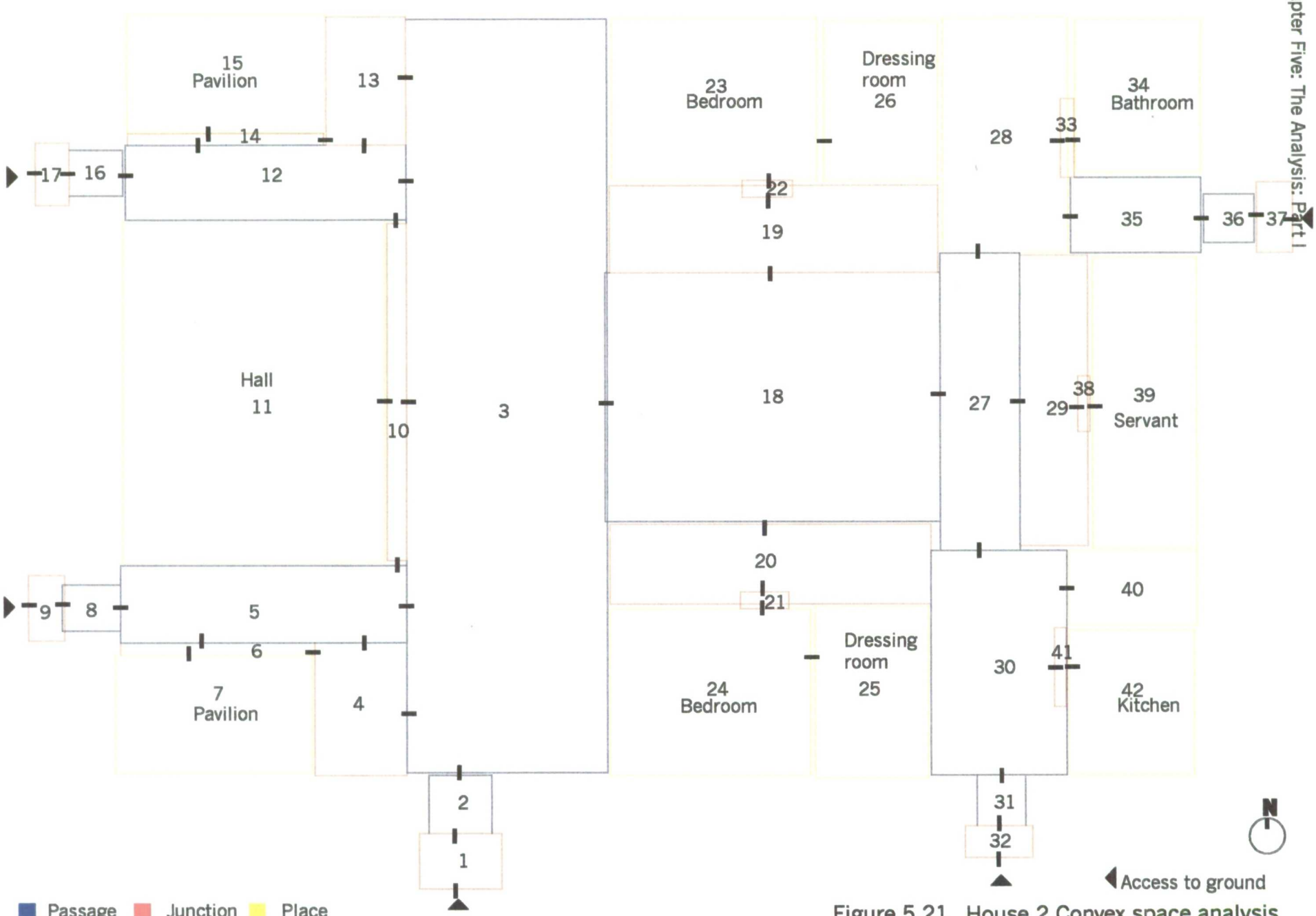


Figure 5.21 House 2 Convex space analysis

Structurally, house 2's graph is interestingly divided into three zones: c-type (levels 1-2), d-type (levels 3-4) and a-b-type zones (levels 5-8). Experientially, there is also a clear, rhythmic pattern in the graph; that is, exterior-junction-passage-junction-place. The most common experience is junction-type space (43%) because the house has five entrances and a strong demarcation between indoor and outdoor spaces. Verandas and steps on terrace space also give this house the experience of junction. However, there is quite a symmetrical distribution of experiential dimensions in house 2 (12 passages, 18 junctions and 12 places). In house 2, the most expansive experience is junction not place-type as in house 1; it is only interrupted on levels two and three. 17 convex spaces or 40% of the house is open spaces of *chan*, of which more than 41% are passage-type paces. As a result, the house is very well connected from everywhere as is obviously reflected in its architectural experience.

House 3's graph is quite complex for a Thai house with nine levels and the second highest SLR value (1.484). d-type is dominant (25 spaces) followed by a-type space (18 spaces) making the structure quite complex and deep (Figure 5.22). This fact is hidden from real experience at the building where the most spaces are visible from almost every place to any other. This is the unique principle of using space to form a structure rather than physical boundaries in Thai houses. House 3 has the highest global integration value of all the selected houses (1.078) from the 41% of the integrated d-type and 26% of segregated c-type structure.

As a whole, a structure seems to be very well conceived at its most expansive part while the total understanding of the structure must be through all levels experience. The most expansive level of house 3 is on level five where d-type spaces dominate. d-type spaces are concentrated on levels three, four and five where there are very few c-type spaces. However, on the other six levels c-type spaces assume the dominant role. The house consists of two structural systems: c-type and d-type complexes which is commonly found in Thai houses that have expanded from small houses. Unlike houses 1 and 2, there is no clear front, middle or back zones. Instead the house has three sub-complexes, each of which is structured around a common area such as spaces 33, 41,46 and 51 (Figure 5.23).

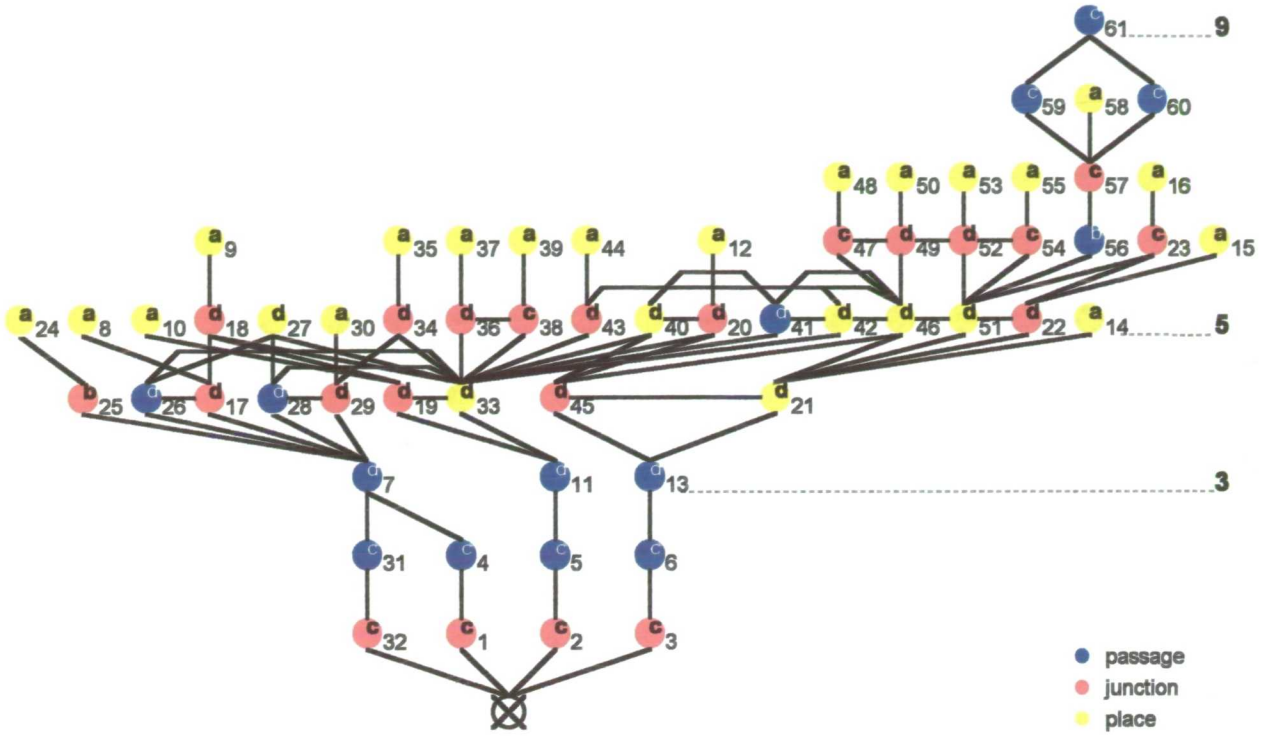


Figure 5.22. Justified graph of house 3
Total space = 61 + 1 ext. and 91 links, Space-Link Ratio = 1.484

House 3 is mainly structured from series of the dominant place-type space such as spaces 33, 46 and 51 forming the centres of the sub-complexes which are linked by passage-type spaces, e.g. spaces 11, 41 and 56. In the graph, small branches of sub-complexes are organised around these key spaces on the *chan* space resulting in more place-type spaces on the *chan* than in other houses. Place-type space is also well distributed in the structure from level four upwards. Junction-type spaces exist in seven out of nine levels and are well distributed with place-type spaces. As a well-integrated structure, only a few good passages are needed; out of 61 spaces house 3 has 14 passage-type spaces. They dominate the structure on levels two and three reflecting the simplicity of the design and movement at the point of contact with exterior space.

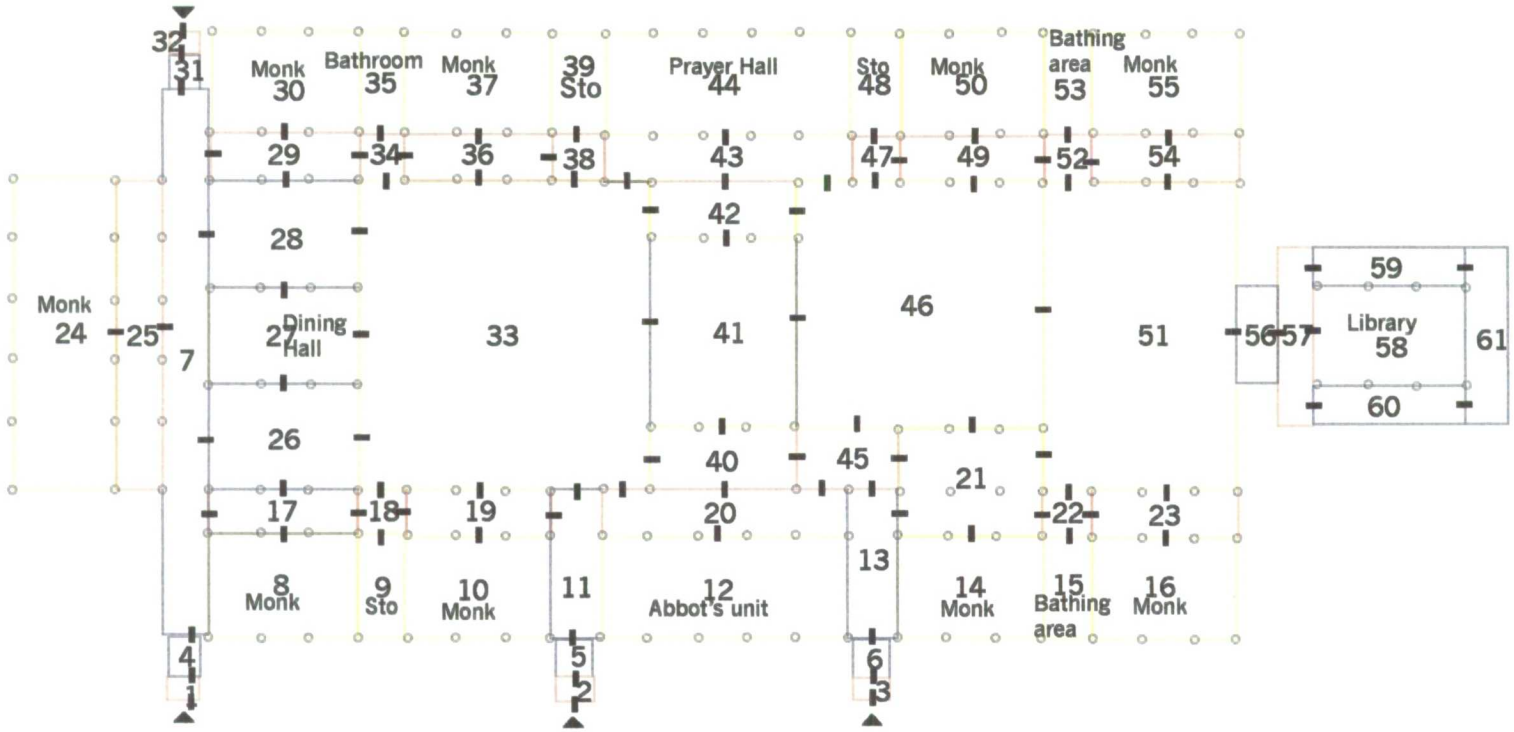


Figure 5.23 House 3 Convex space analysis

The contemporary Thai houses:

House 4 contains the highest number of convex spaces (91), the deepest graph (12 levels) with the highest SLR at 1.489 (137/92) and the highest number of connections of all houses (Figure 5.24). d-type space is again the dominant type at 46 spaces. Despite the high number of d-type complexes, their depth minimising effect does not influence the whole structure as much as c-type complexes do on the global scale. As a whole the house has the second lowest mean integration value (0.744) corresponding to the fact that it has a deep and fragmented structure as shown in its justified graph. With 52% d-type and 29% c-type space, the structure still has a segregating character which seems to be the result of its configuration not only because it is a two-storey house.

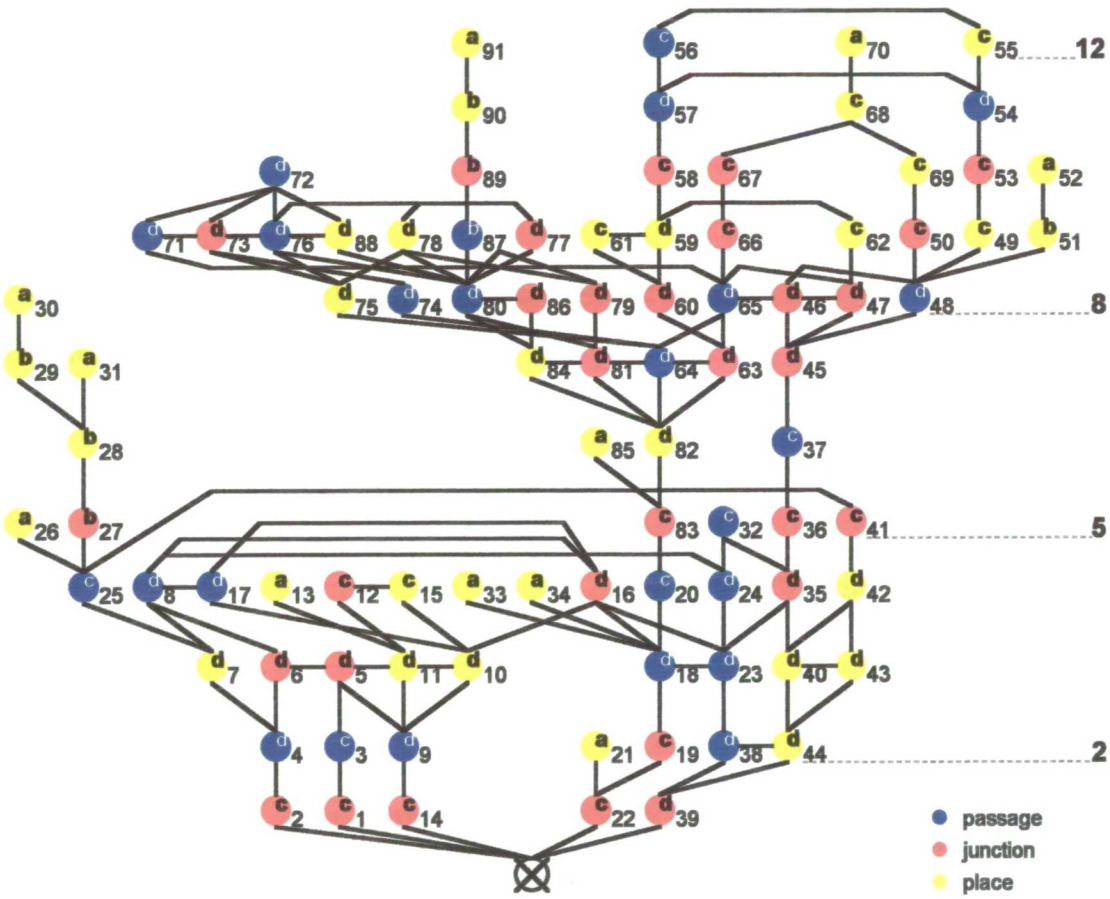


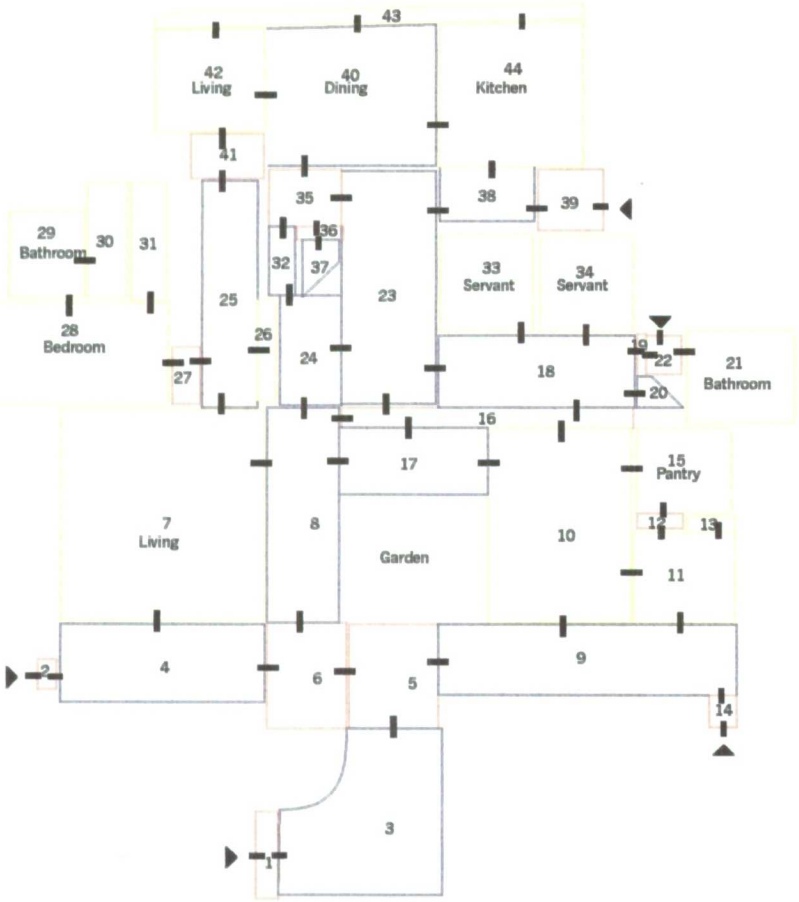
Figure 5.24. Justified graph of house 4
Total space = 91 + 1ext. and 136 links, Space-Link Ratio = 1.489

The most expansive level of the structure is level nine with 14 cells; more than 50% of which are d-type spaces which dominate on levels seven, eight and nine representing *chan* space on the upper floor of the house. Overall, the structure is very much controlled by d-type spaces that range from level one to eleven. The justified graph can clearly be seen

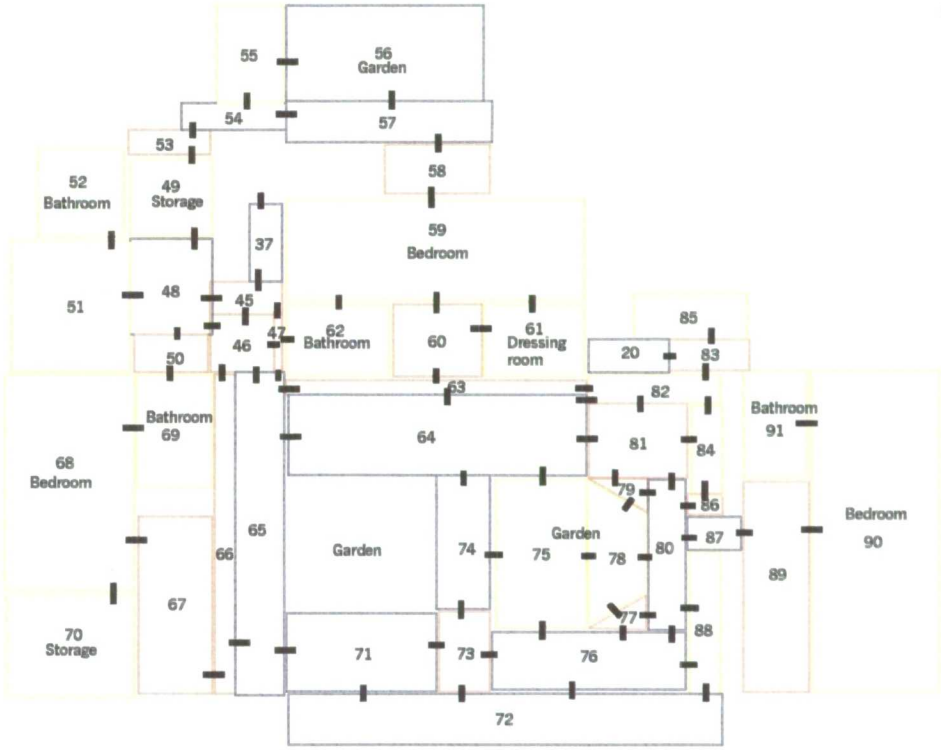
to have two structural loci representing the lower and upper floors with the connection at levels four to six; spaces 20 and 37 connect the upper with the lower level. On each locus, *chan* spaces create complex structure in which connections are gyrated round among many spaces. This is the possibility of either expansion or compactness of the structure from and to these spaces (e.g. spaces 16 and 23 on the lower locus and spaces 65 and 80 on the upper locus).

House 4's structure has a high number of circulation spaces. Spaces are fragmented and tied to one another by many passage- and junction-type spaces (62%), especially in the lower level which has gone through many changes. The passage-type space has the highest mean integration value at 0.788 (Appendix, table 5.7.4) with the fewest members (25 spaces) reflecting in house 4's large proportion of open space (45%) and a balanced proportion of enclosed (26%) and connecting spaces (29%). The structure also has quite a contrast proportion of passage-, junction- and place-type spaces (28, 34 and 39%, respectively). The most widespread, across and within levels, is place-type space even though many key spaces in the structure are passage-type spaces, especially those on *chan* space e.g. spaces 8, 23, 64 and 65 (Figure 5.25).

House 5 has a balanced number of a-, b-, c- and d-type spaces (18, 11, 15 and 14 spaces, respectively). The justified graph of house 5 is much less complicated and five steps shallower than house 4's which is quite simple considering that it represents a two-storey house (Figure 5.26). It is a seven-level structure, the shallowest of all the selected houses. The structure has 74 connections and is just as complex as those in a one level house such as houses 1 and 2 (same 1.2 SLR). There is no obvious split between the two levels in the graph; that is, the connecting spaces (e.g. spaces 20, 21, 30, 31 and 32) are well-integrated into the structure and some are very shallow and direct. The house has the highest number of b-type of all selected houses (11 spaces). These b-type complexes at times are not so segregated but merge into the main body of the structure, e.g. spaces 14 and 48 complexes. a-type space has the most members (18) but globally c-type spaces are the most influential type. House 5's structure is well-rounded and balanced in terms of spatial types and configurations.



Ground floor



First floor

N

Access to ground

Passage Junction Place

Figure 5.25 House 4 Convex space analysis

Levels two and three are the most expansive levels with eleven nodes. There are 10 d-type spaces out of 22 spaces in these two levels; all are *chan* space on both floors. The most widespread space type is a-type spaces which range from levels one to seven while b-type spaces are on levels one to six and c-type spaces are on levels one to five. The role of d- and c-type spaces in house 5's structure is the reverse of those in house 1. d-type (e.g. spaces 5, 13 and 9) here seem to focus on internal structure while c-type spaces (e.g. spaces 6, 30 and 42) connect different parts of the structure together. Some spaces present themselves as crucial in managing connections (e.g. spaces 3, 13, 34 and 47); all are d-type and *chan* spaces.

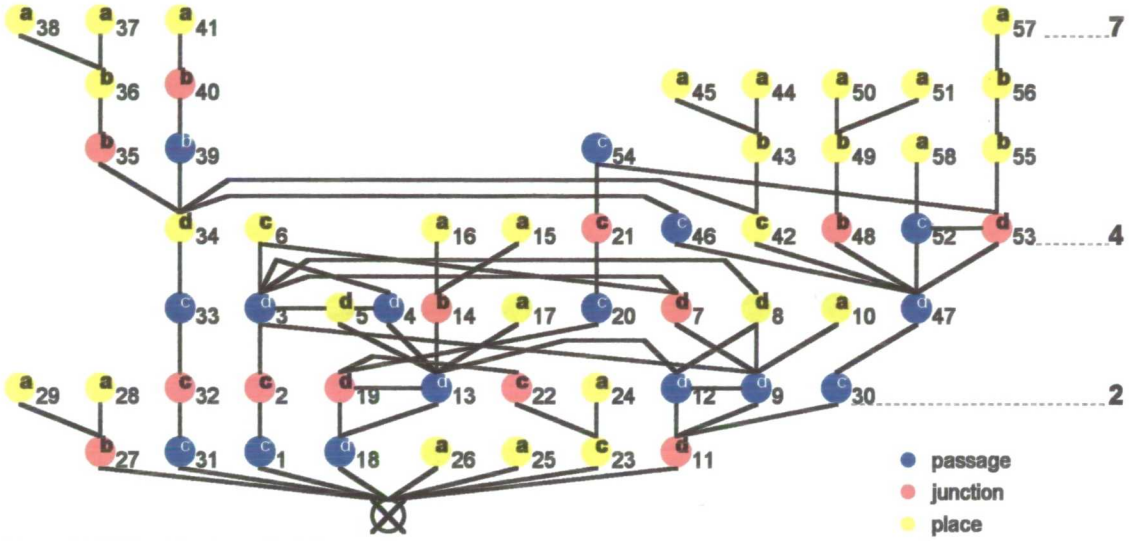
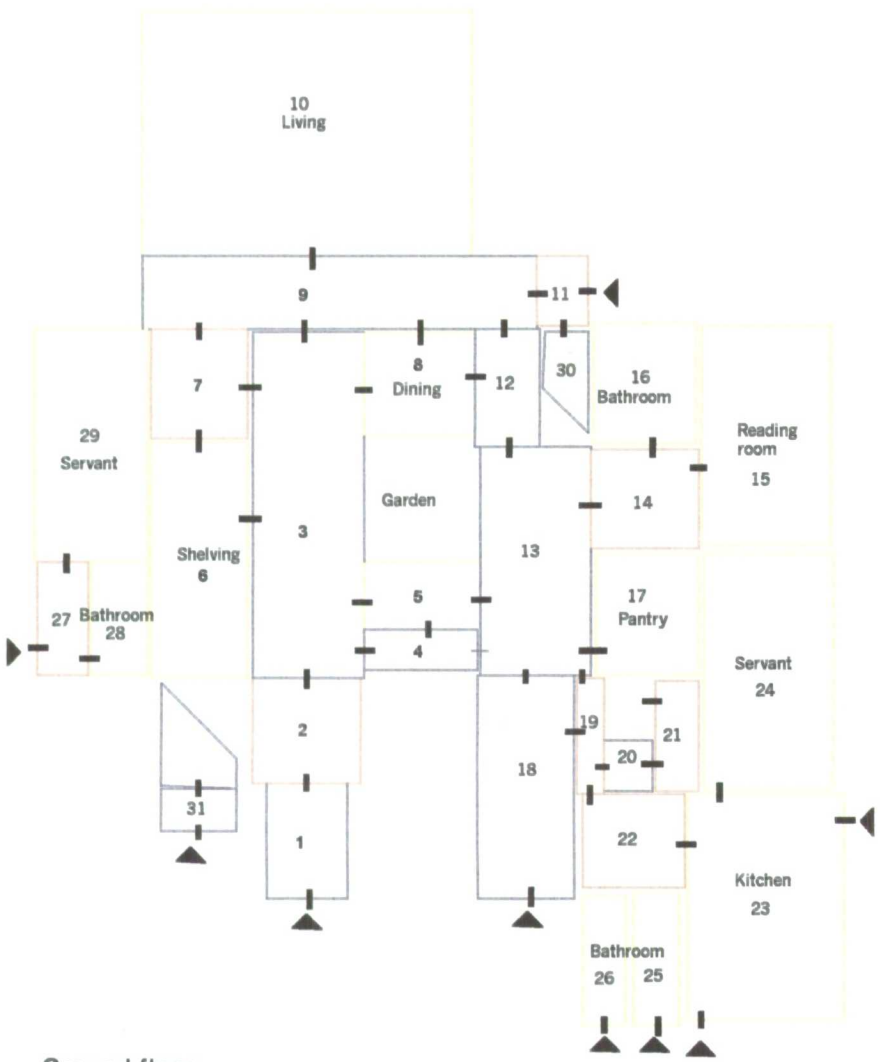
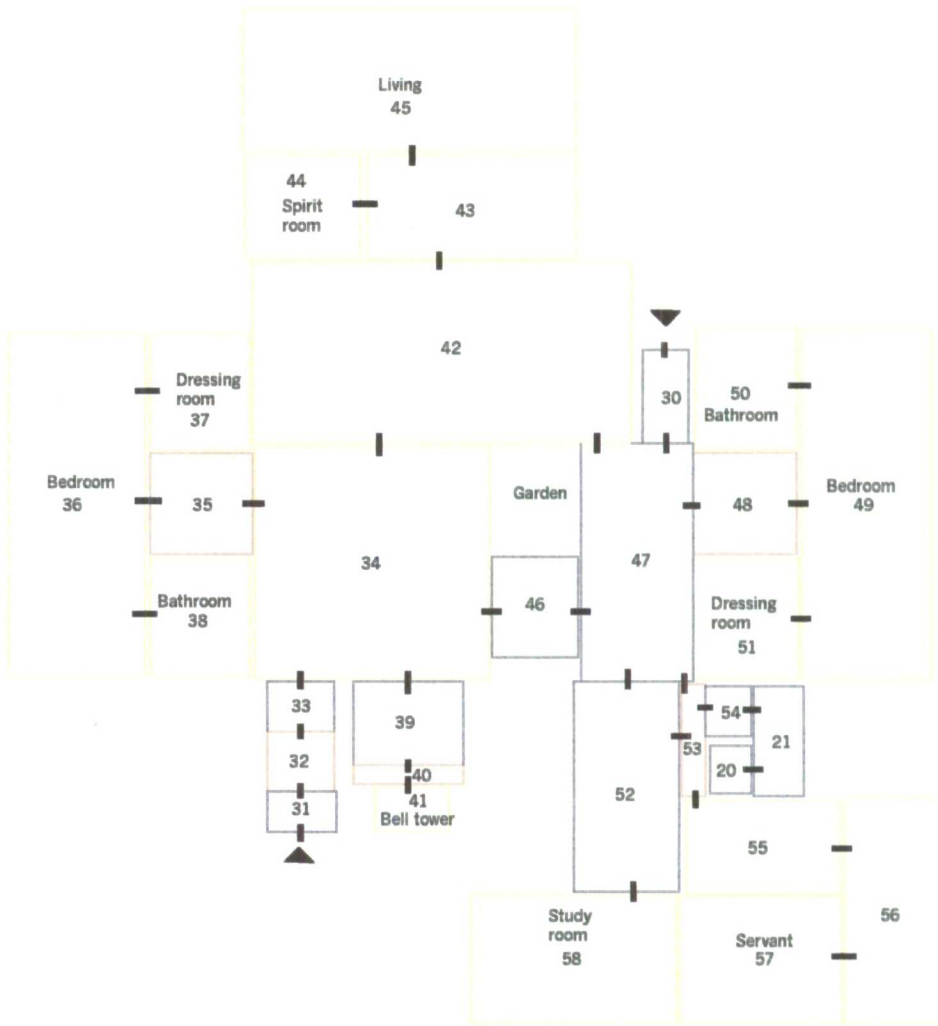


Figure 5.26. Justified graph of house 5
Total space = 58 + 1ext. and 74 links, Space-Link Ratio = 1.271

The house is very easy to get around with three stairs (spaces 20-21, 30-33 and 54). One is at the front as the main entrance and the other two are at the back leading to the garden and service sector. We have seen in house 3 that to construct a well-integrated structure only a few good passage-type spaces are needed. This two-level house has 16 passage-type spaces (28%) while house 3 has 14 (23%). The most common experiential type in house 5 structure is place-type space (50%). They are present in every level resulting in the highest b-type spaces of all selected houses (11). The outdoor and indoor spaces in this house is also quite balanced at 23 enclosed spaces and 21 *chan* or open spaces (Figure 5.27).



Ground floor



First floor

N

Access to ground

Passage Junction Place

Figure 5.27 House 5 Convex space analysis

House 6 has the highest number of a-type spaces of all the houses (28). The complex is absolutely symmetrical along the east-west axis, in both graph and plan (Figures 5.28-5.29) with only three rings in its justified graph resulting in the least integration value and SLR (0.703 and 1.056, respectively). However, it is not the shallowest structure at eight levels. a-type (28 spaces) is dominant followed by 13 c-type spaces. There are only two d-type spaces in the structure due to the compactness and straightforward character of the house. Parts of the building, e.g. living units or shared facilities, are accessed directly and independently without sharing a common network with others.

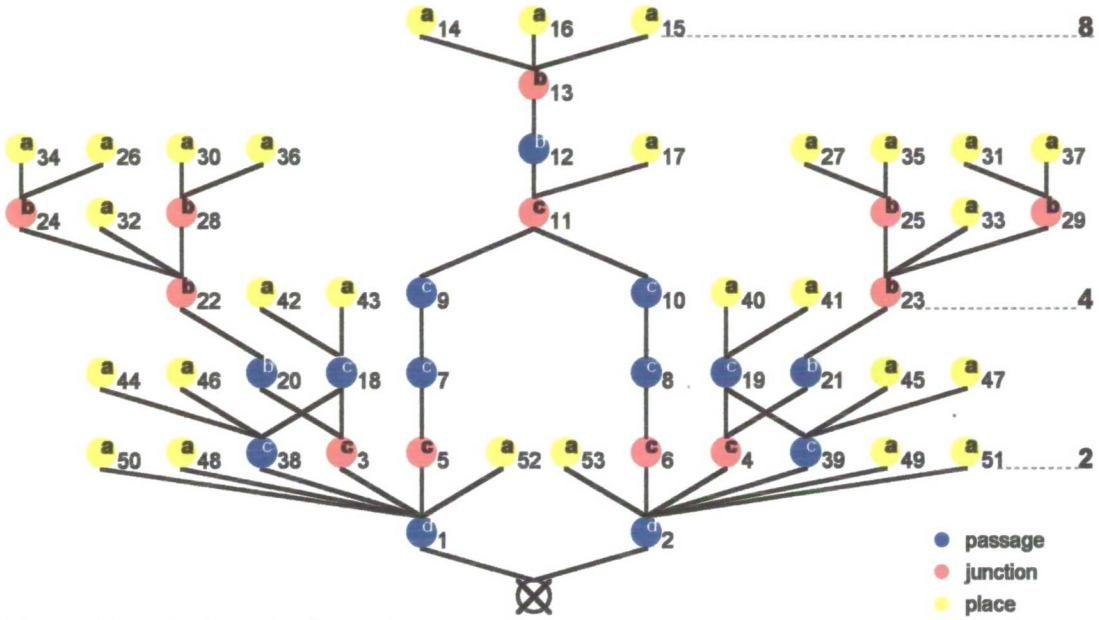
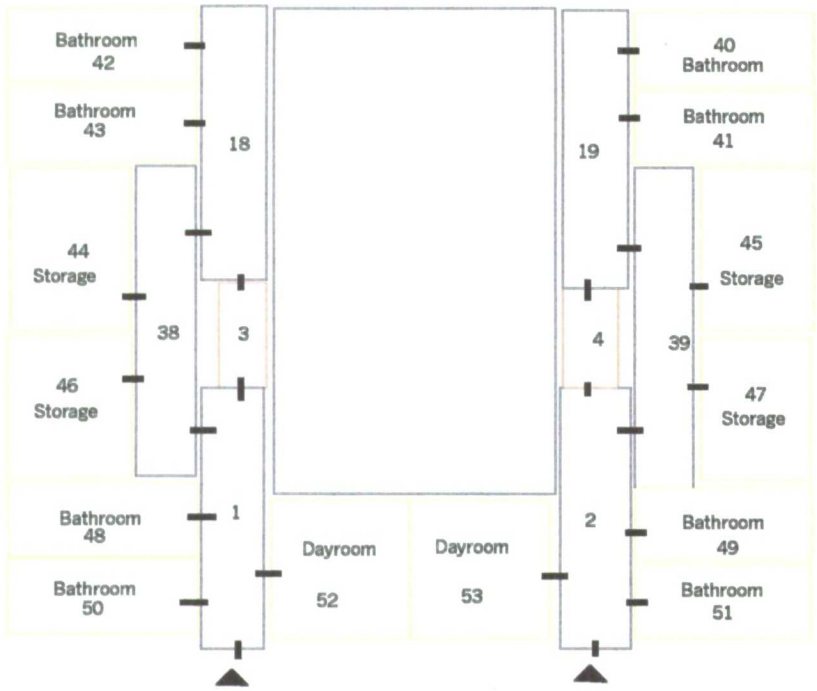
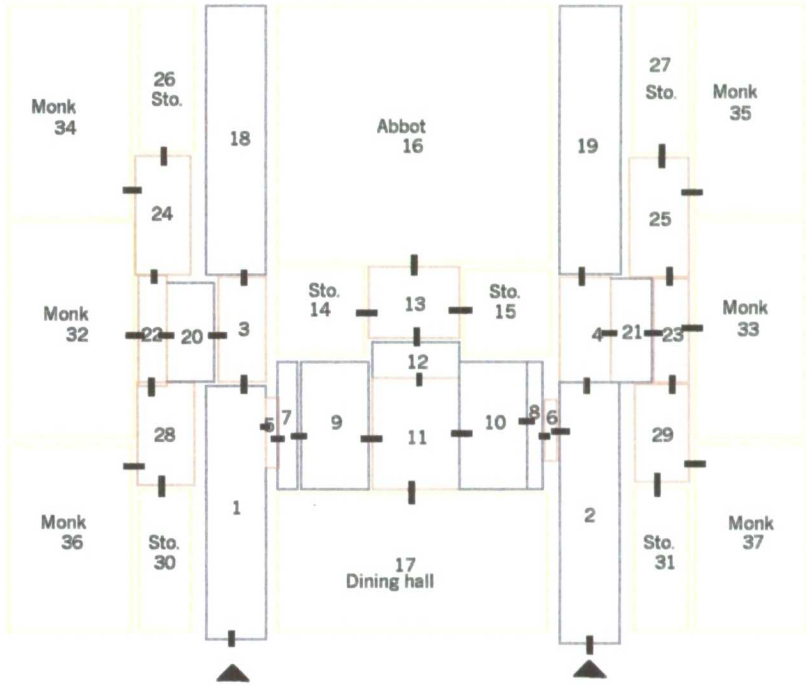


Figure 5.28. Justified graph of house 6
Total space = 53 + 1ext. and 56 links, Space-Link Ratio = 1.056

The most expansive level of the structure is on levels two and three involving twelve spaces. The graph's key spaces are spaces 1 and 2. They have the biggest global impact on the whole structure because they are the only two spaces that connect the three branches of the graph together. c-type spaces construct the sub-complexes of each branch and completely separate the sub-complexes from one another. It is clear that c-type (13 spaces) controls the structure as a whole even though b-type (10 spaces) are spread across more levels. This fact corresponds to the simplicity and perhaps compactness of house 6 since a b-type space requires the least connections and the shortest way to go from one space to another. The structure has 10 b-type spaces making it the only house that has more b-type than d-type spaces.



Ground floor



First floor

N

Access to ground

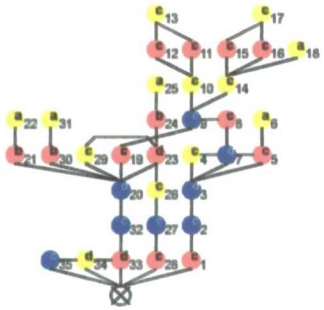
Passage Junction Place

Figure 5.29 House 6 Convex space analysis

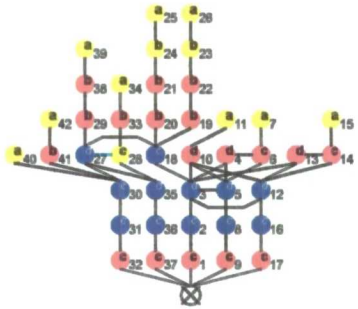
The first impression of this house is of its compact size. Only four spaces of passage experiences play a vital role in the existence of the complex (spaces 1, 2, 18 and 19); without them the house would be split into three houses instead of one. Since place-type space is so dominant in proportion here (53%), the experience of being 'cut off', to preserve privacy, is common. The general experience of the structure is more introverted and abrupt as suggested by the high number of place-type and low number of junction-type spaces. The open space or *chan* of house 6 (30%) is split into three levels: the street level, the common space level and the living level, e.g. spaces 1 and 2 on level 1, 7-11 on levels 3-5 and 32-37 on levels 5-6, respectively.

In conclusion, there are many similarities in the selected Thai house spaces when presented in the form of justified graphs. Firstly, the selected houses are shallow structures as a whole. No more than twelve steps are needed to reach the structure's last space from the outside. The average depth of all houses is nine steps. Secondly, it seems that the key spaces of architecture are on the levels that have the highest number of spaces. Open spaces or *chan* spaces often dominate this most complex part of a house's structure. The most expansive levels of the selected Thai houses' structures are between levels three to nine; the average level is on level five.

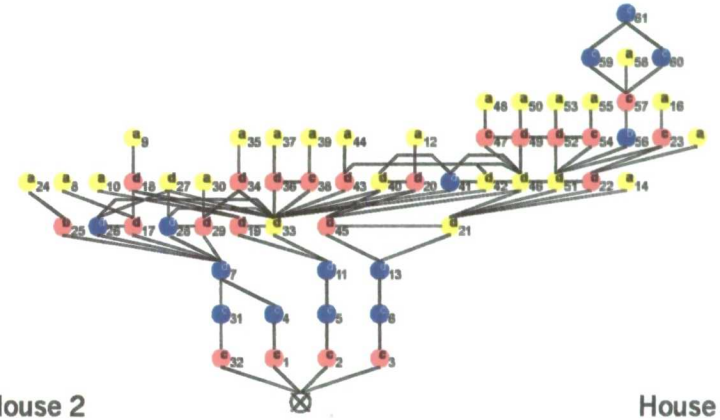
Thirdly, a structure takes its character from the way its nodes are connected. As expected, d-type space has the most control because of its constructive nature. However, as a whole, a structure seems to acquire its logic from the most common and widespread type spaces. Place-type space is the most dominant and widespread in all selected Thai houses (Figure 5.30). Generally, c-type spaces are often more widespread than the controlling d-type spaces. Finally, Thai houses use spatial partitioning to create sub-complexes on *chan* spaces. This design creates complex spatial configurations that do not show on the plans.



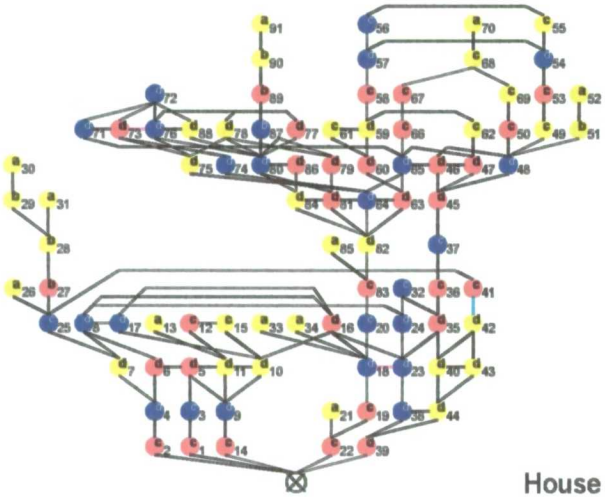
House 1



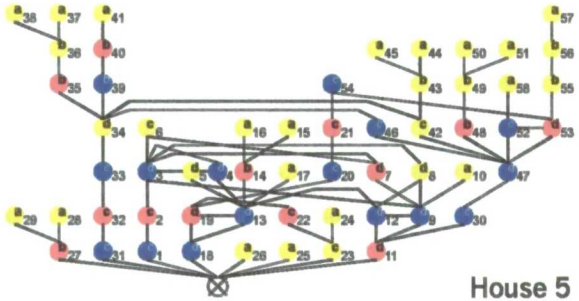
House 2



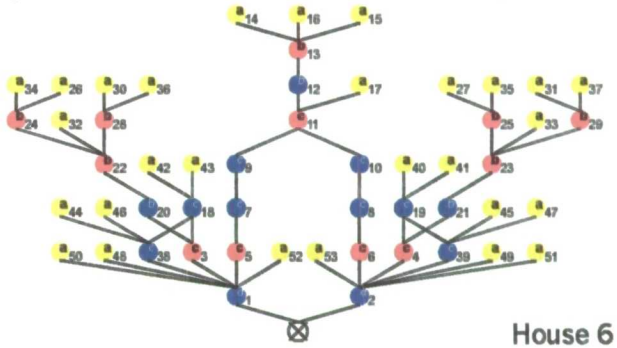
House 3



House 4



House 5



House 6

passage
junction
place

Figure 5.30 Structure of houses 1-6

Justified graph analysis of the selected Thai temples

From the convex space analysis, the most basic design aspect of Thai temples is the use of the cardinal point-based *mandala*. The concept of major and minor axes as the backbone of the whole structure seems to stand out as well as the common use of terrace space. The *ubosot* represents the religious direction to be followed by the rest of the complex being as both the physical and psychological centre of the whole temples' space. The justified graph analysis of the select temples will follow the above mentioned points as they are portrayed in forms of graphs. The advance made by this analysis is that we will be able to pinpoint some spaces or groups and types of spaces that have certain effects on a temple's structure and perhaps more importantly the causes of these effects. The following analysis approaches the selected temples in their structural dimension starting from the deepest part, often the *ubosot*, toward the root of the structure followed by analytical works on space types and their roles in a structure.

The conventional Thai temples:

Temple 1 has 12 entrances connected to exterior space which makes its graph very complex and ringy (Figure 5.31). The temple's structure has 21 levels; the majority of cells are at depths seven and eight. The *ubosot* are isolated from the rest in the deepest area of the graph (levels 14 to 21). The *ubosot* space is controlled by two convex spaces (spaces 642 and 654) on level 14 which have the second highest control value (13.3). These two spaces are parts of the upper terrace that connect the front and back parts of the *ubosot* together. They both lie on three rings with one ring link to the lower terrace through stairs at spaces 627-630 (Figure 5.32). The black cell in the graph represents the Buddha image. Space 734 on level 20 is the most important space of the complex; it is the prayer hall which is the ultimate destination for all worshippers and visitors.

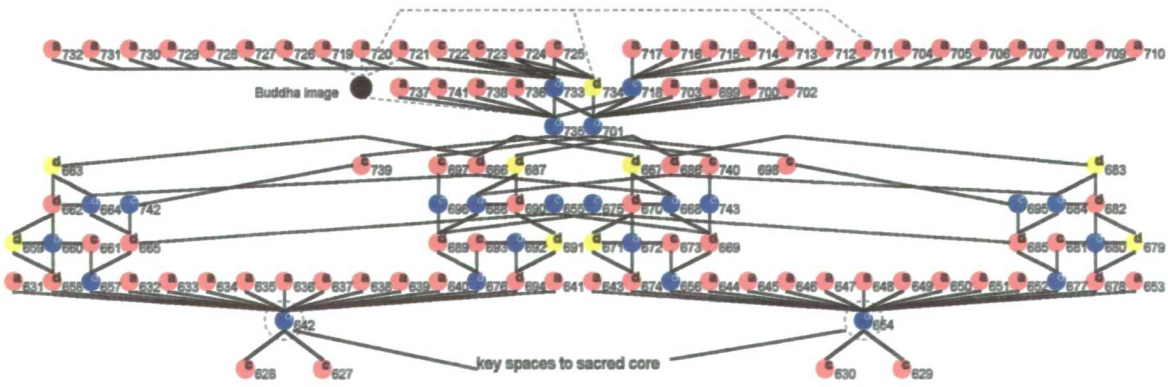


Figure 5.32 Key spaces, spaces 642 and 654, in temple 1

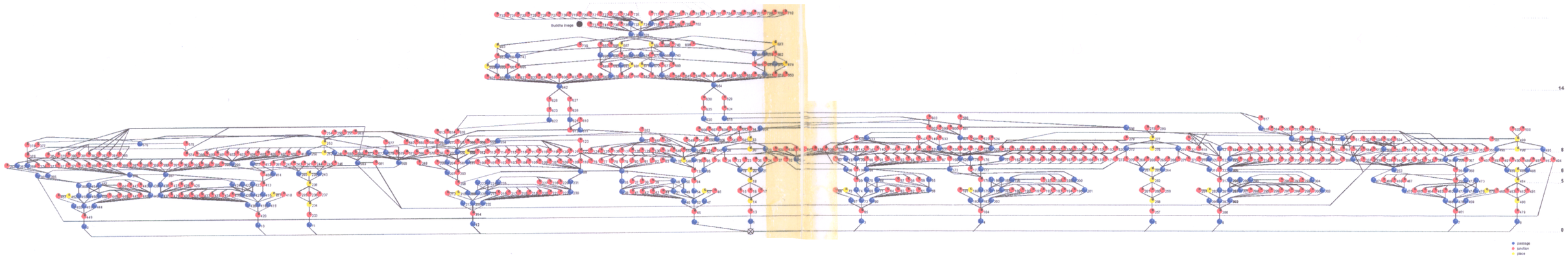


Figure 5.31 Temple 1's J-graph
Total space = 743 + 1 ext and 1126 links, Space-Link Ratio = 1.515

-Level 14 to six

One of the most significant features of Thai temple architecture is terraces which are spread across levels twelve to seven in temple1's structure. It is an effective penetrative device that inserts itself through many structural levels. By being next to the cloister, the terrace has its gathering effect and it delivers people to the deep core (Figure 5.33). From levels eight to six lie the spaces of the inner cloisters. They are in the most expansive levels in temple 1's graph suggesting that they are the most difficult to grasp by moving in them. However, this also suggests the shallowest notion of permeability from and to these spaces. Cloisters in Thai temples are commonly used to differentiate the sacred from the profane area of monasteries.

-Level five to root

The graph from level five to the root has a tree-like character with sub-complexes suggesting straightforward movement from the exterior space with alternative interests (the courtyards) along the way (Figure 5.34). The sub-complexes on levels five and four of the graph represent the courtyards that are surrounded by the outer cloisters (e.g. spaces 421-436). Spaces 1 to 12 represent entrances on the first level. Entrances 2, 3, 4, 6, 7, 9, 10 and 12 are originally designed as sub-entrances and shallower than the rest; they become more practical than the symbolic entrances (spaces 1, 5, 8 and 11) through the directional halls.

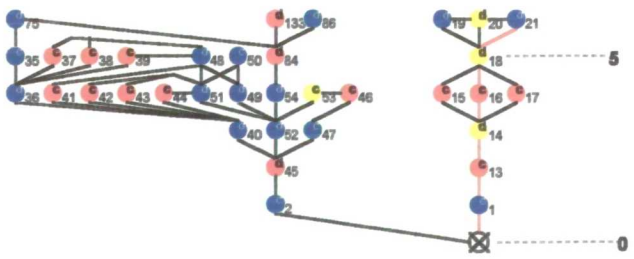


Figure 5.34. Level 5 to root, temple 1

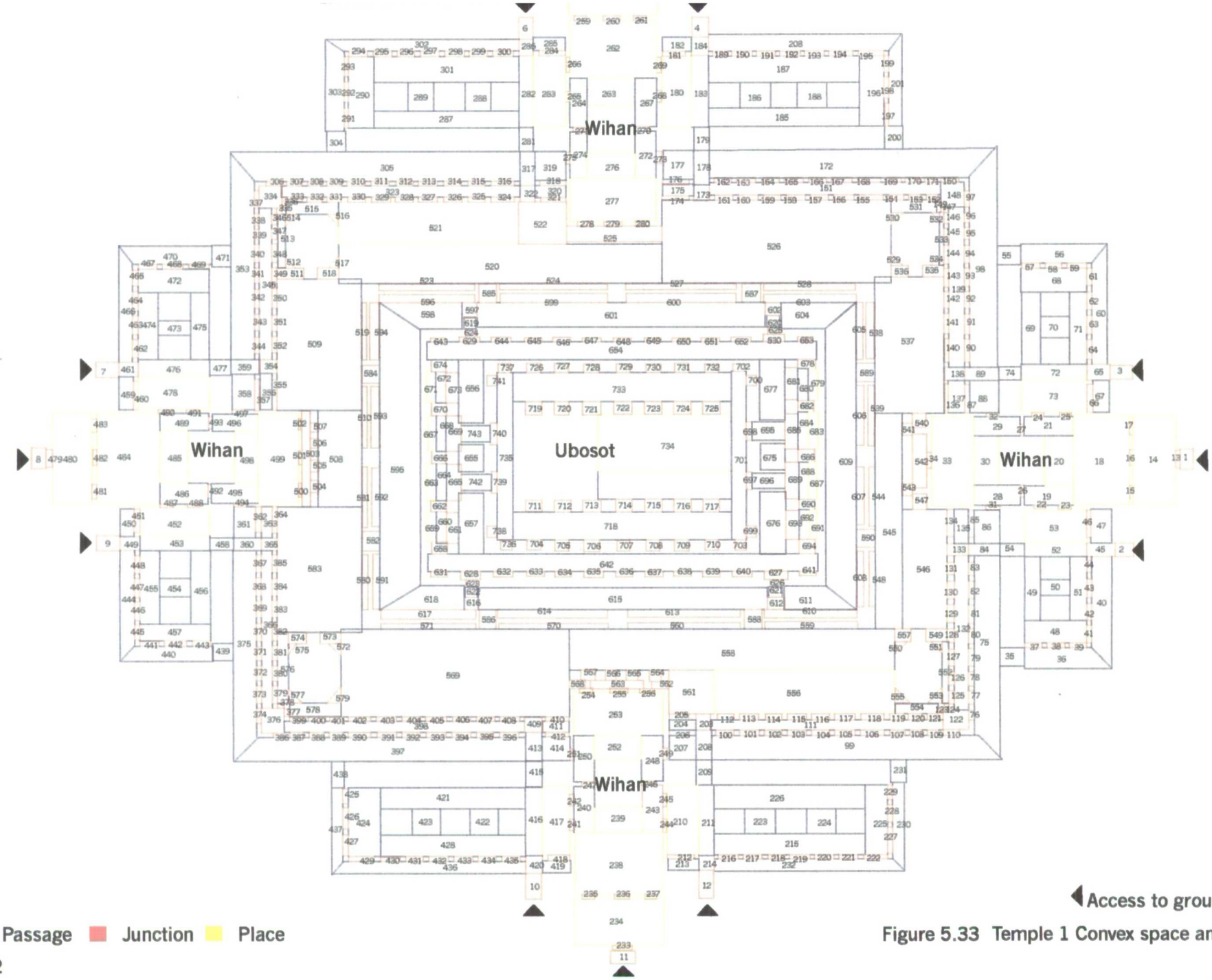


Figure 5.33 Temple 1 Convex space analysis

The most common space in temple 1 is junction type (505 spaces). Most of the junction spaces represent the cloister where many of them are connected to key passage type-spaces of the cloister (e.g. spaces 111, 151, 323 and 398) and of the terrace (e.g. spaces 537, 526 and 569). Junction spaces are expansive in both horizontal and vertical directions of the graph (from level two to 21) representing 68% of Temple 1's space. There are 402 c-type spaces (54%); most of them are cloister and terrace spaces which are connected by strong d-spaces. c-type space is very expansive, from the first to the last level, especially on levels seven and eight representing the cloister which creates either an accelerator or barrier effect in local scale. In this way, the depth minimising spaces such as d-type complex or terraces are more involved in the global circulation of the system more than the depth maximising spaces, e.g. c-type spaces or cloister spaces (Figure 5.35). The relations among c-, junction, passage, cloister, terrace and d- type are very important in Thai temple designs as will be further discussed in the theoretical analysis.

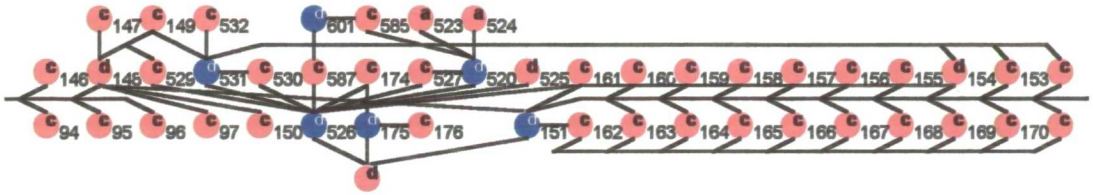


Figure 5.35. Depth minimising, e.g. space 526 and depth maximising spaces, e.g. space 153-170, in temple 1

Passage space is naturally very penetrative as it covers a big part with a relatively small number of spaces; 198 passage spaces cover levels 1 to 20. They also handle more spaces than other types especially in the cloister where a passage handles many c- and junction-type spaces. Similar to passage spaces, d-type spaces are pervasive in the graph from levels 2 to 20. At 32% of temple 1's space, d-type spaces connect with many c-type in the middle of the graph and with many a-type spaces along the way and at the deeper end of the graph. Only 6% of the temple space are place-type spaces but many of them are very well integrated and are in very important function, e.g. prayer hall in the *ubosot*. The *ubosot* is at the deepest level and connected to the terrace only through spaces 642 and 654. With cloister and terrace, the temple's structure is dynamically expands and contracts with the centre at the *ubosot*. Among the selected temples, temple 1 has the largest proportion of open space (76%) with the majority of its spaces being junction- and c-type spaces (505 and 402 spaces, respectively).

Temple 2 is one of the biggest temples in Thailand. Its structure has the highest number of connections of all temples but with the least mean integration value (0.604). Its justified graph contains 23 levels with the most expansive level at level 11 (Figure 5.36). The temple has 10 entrances around its periphery and four entrances around the *wihan* which is located at the deepest area of the structure (levels 13 to 23). The *wihan* contains 150 convex spaces which are accessible through only four spaces on level 13 (spaces 1009, 1012, 1047 and 1051). In the *wihan* sub-complex, the structure is dominated by junction-type while d-type spaces have more controlling roles. Among four place-type spaces in the *wihan*, spaces 1161 on level 21 is the prayer hall which is the most important space in the temple (Figure 5.38). The location of this space is said to be on the centre of Bangkok and according to the *mandala* it is also the centre of the universe (Figures 5.37).

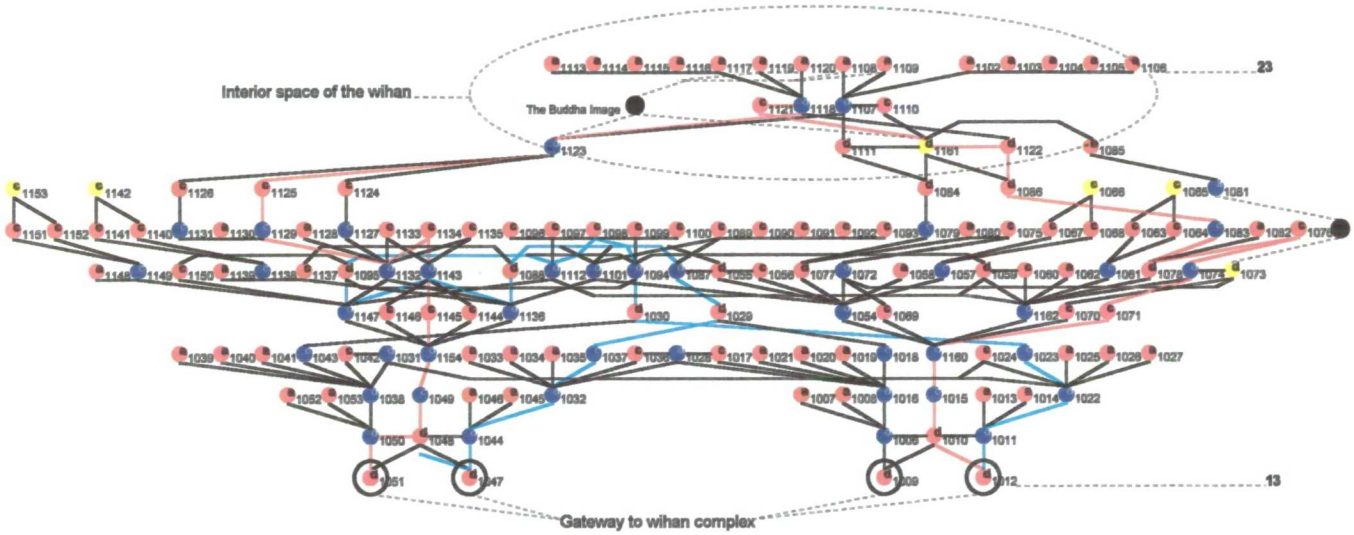


Figure 5.38. Structural dimension of the *wihan* at temple 2

-Level 19 to 6: the *ubosot*

The *ubosot* is located at the back of temple 2 as well as at the deepest part of its structure. The *ubosot*'s interior spaces start at space 759 on level 15 until 17 and at space 754 on level 16 until 18. Unlike the *wihan*'s space, parts of the *ubosot*'s space, such as its lower terrace (e.g. spaces 644 and 645 on level 6), are very shallow from exterior space. Comparing the two most important buildings in temple 2, the *wihan*'s spaces involves 11 levels isolated at the deepest part of the structure while the *ubosot*'s spaces involve 13 levels and blend in with other parts of the structure (Figure 5.39).

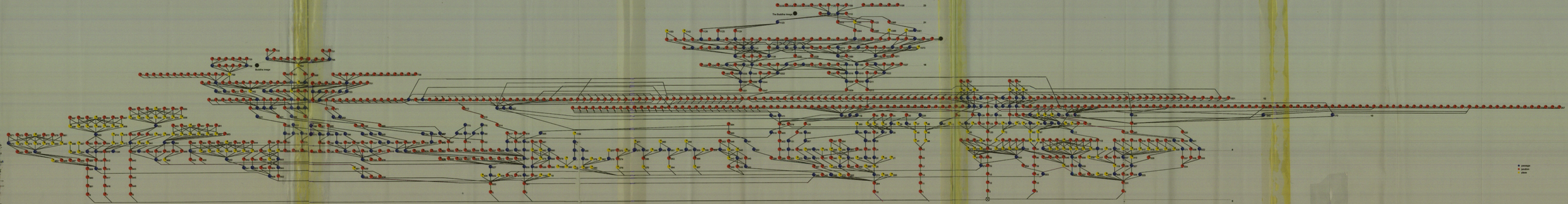


Figure 5.36 Temple 2's J-graph
Total Space = 1168 + 1 ext and 1706 links, Space-Link Ratio = 1.460

235

Ubosot

Wihan

Passage Junction Place

Access to ground

Figure 5.37 Temple 2 Convex space analysis

236

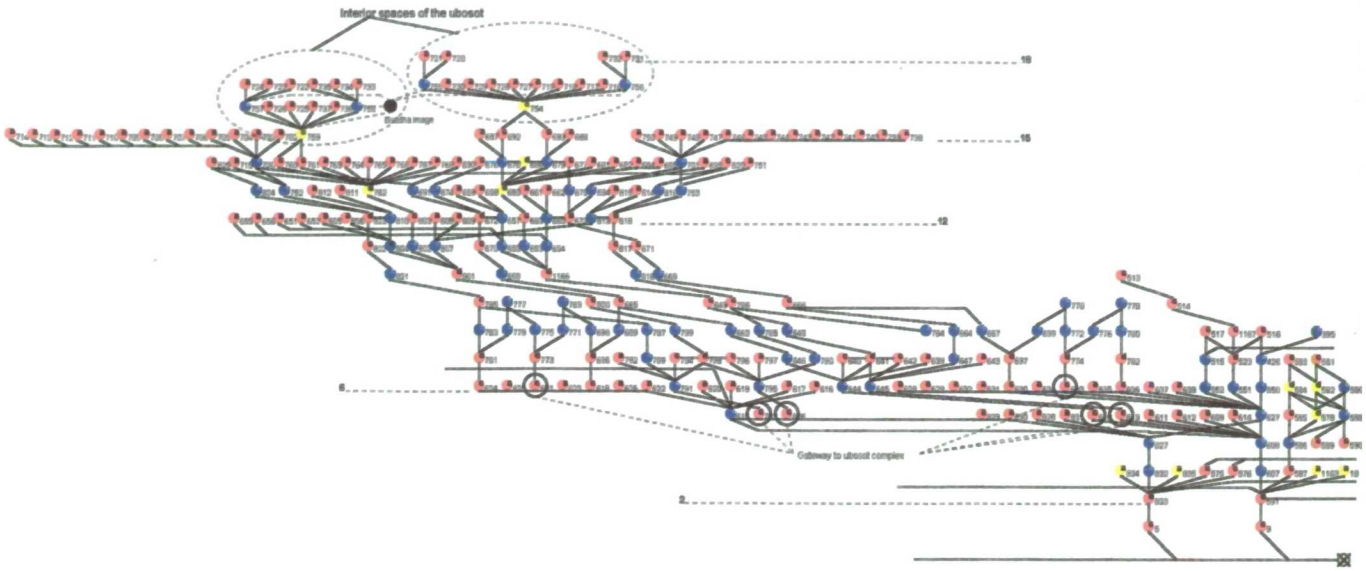


Figure 5.39. Structural dimension of the *ubosot* at temple 2

-Level 12 to 10

The most expansive levels of the structure are levels 11 and 12 where most of the nodes represent cloister spaces around the *wihan* complex. The formation of this temple's cloister spaces is more expansive and isolated than those in temple 1. There are more than 600 connections among levels 10, 11 and 12; that is, more than 1/3 of the connections in this structure are involved with the cloister system. The main terraces (spaces 226, 227, 228 and 969 on levels 10 and 11) collect movements from the cloister and direct them through four spaces on level 12 (spaces 973, 976, 999 and 1002) which deliver people into the inner terrace of the *wihan*. Other spaces on these three levels are in the two pavilions (spaces 70-80 and 50-60) by the main entrance at space 2.

-Level 10 to root

From level 10 to the root, the majority of spaces represent the small pavilions and pocket spaces along the temple's walls (e.g. spaces 895-908 and 592-601). If one starts from entrance 9, the *ubosot*'s spaces are only five steps away while it takes as many as 18 steps to reach the *wihan*'s space when starting from entrance 7. The temple's periphery is structured as another layer of the successive wave-like design. Next to these peripheral spaces, there is another system of connections which are inside the temple's open courtyard. These connections are mostly passage-type spaces that provide short cuts or alternative routes to many parts of the temple.

For example, spaces 1155-1157, 390, 553 and 126-128 have long and transverse connections throughout the graph; they tie up different parts of the temple's structure. Some of them are as shallow as level three and provide another structural system that wraps around the two centres, the *ubosot* and *wihan.* They enhance and at the same time filtrate movement to and from the inner and outer structure of temple 2. This creates a more straightforward accessibility than in temple 1, especially at the east and west entrances (spaces 4, 5, 9 and 10). Furthermore, from the main entrance (space 2) one can reach the inner structure of the *wihan* in 15 steps compared to the 27 steps required to reach the inner structure of temple 1.

Junction-type in the cloister is the most common (744 spaces) and the most widespread space (levels 1 to 23). Junction-type spaces are distinctively dominant in many parts of the structure such as on levels 11 and 12 where they represent the cloister space and in the structures of the *ubosot* and *wihan.* For most of the entrance spaces the sequences of entering the temple are also mostly made up of junction-type spaces. Place-type spaces are well-distributed in the lower part of the graph; many of them are spaces from the pavilions around the perimeter. Of all 180 place-type spaces, only five are in the *ubosot* and six in the *wihan* however they are all very important and religious-based spaces meaning that the systems are configured to serve them.

Certain sequences and types of connection are used to emphasise the main prayer hall (space 1161). These design strategies are applied into certain routes in temple 2 as well as in other selected temples as route analysis will show. More than 56% of the temple spaces are c-type (655 spaces) while 23% are d-type and 19% are a-type spaces. The graph also clearly shows that different parts of temple 2's structure are linked together by a few key spaces; many of them are passage-type (e.g. spaces 226, 390 or 627). The graph basically comprises six parts: 1) at entrances 6, 7 and 8, 2) at entrances 5, 9 and 10, 3)at entrances 1, 2, 3 and 4, 4) at the cloister, 5) at the *ubosot* and 6) at the *wihan.* As a whole, temple 2's structure (56% c-type and 24% d-type spaces) seems to be a complex of independent groups of spaces that are more loosely linked together than in temple 1 (54% c-type and 32% d-type spaces).

Temple 3 is one of the smallest temples in Thailand. However, its structure is quite complex (space-link ratio of 1.344) considering that it has only 130 spaces (Figure 5.40). The structure has 13 levels and can be seen as having three parts. The first part (levels 1 to 5) represents the cloister, entrances and front courtyard. The temple connects to exterior space through four entrances (spaces 1, 52, 53 and 76 on level 1) which are aligned on the major and minor axes of the temple. The second part (levels 6 to 8) represent cloister and terraces which are the most complex part of the graph with 65 links among 59 cells; that is, 37% of all connections and 45% of all spaces are on these levels. The third part (levels 9 to 13) represents the *ubosot* which has 22 spaces including the prayer hall (space 105 on level 13).

The most expansive level is level 7 with 26 terrace and cloister spaces which are more integrated into each other's structure than those in temples 1 and 2. These terrace and cloister spaces (on levels 6, 7 and 8) are configured into series of rooms that are closely connected to one another. The most expansive space is still the cloister which usually has a strong segregation effect in a Thai temple. Temple 3's structure has cloister spaces in nine out of its 13 levels. The cloisters absorb crowd movement before pushing these restrained movements into bigger streams of movement on the terrace which then drives movement further toward the inner core of the temple.

As a whole, the cloister integrates the main elements of this temple: terraces, main entrance (space 1) and east courtyard. At the same time, it shields the *ubosot* by its enclosed character which is dominated by c-type spaces that work well with the d-type in terrace space. The majority of cloister space is junction-type spaces (35 out of 50 spaces). In temple 3, junction-type space also dominates and is the most widespread experience covering levels 1 to 13 (except level 11). There are only four place-type spaces but they are all very important spaces of the temple such as space 78 which is a prayer space that contains a sacred monument. Passage-type spaces are 41% of the temple spaces, a large proportion comparing to the much bigger temples 1 and 2; they make up 37% of temple 3's open space (Figure 5.41).

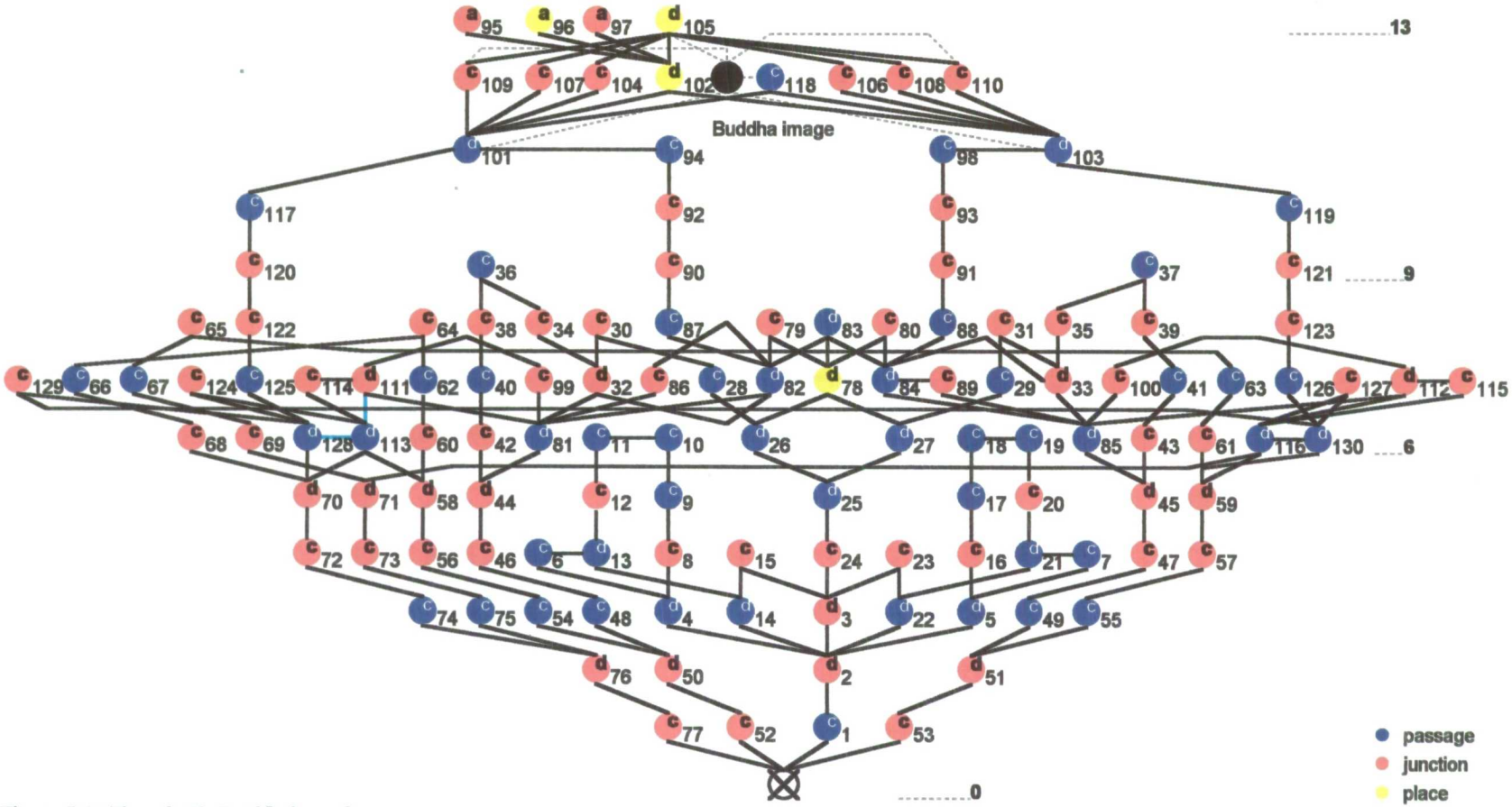


Figure 5.40 Temple 3's Justified-graph
Total space = 130 + 1ext and 175 links, Space-Link Ratio = 1.344

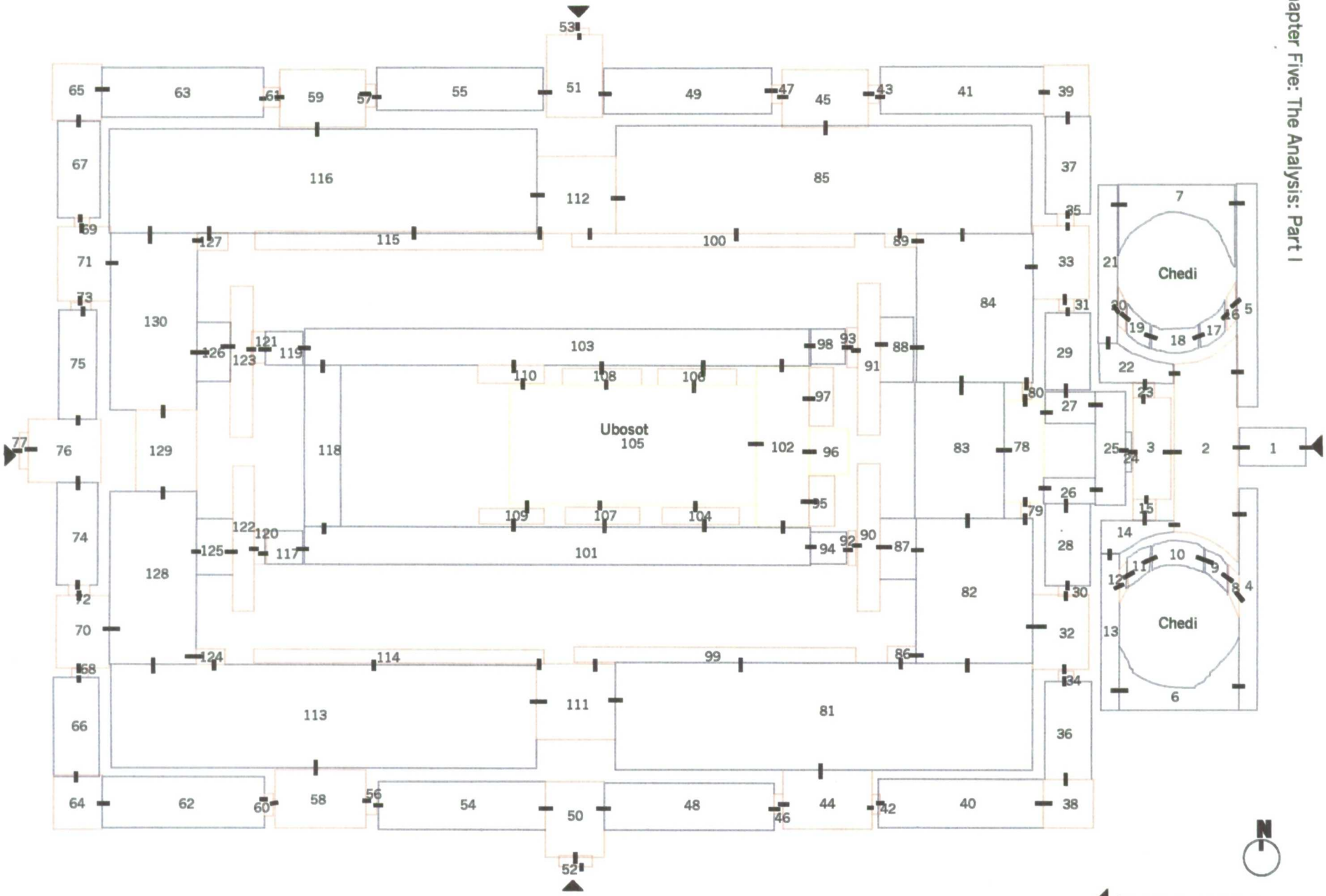


Figure 5.41 Temple 3 Convex space analysis

The contemporary Thai temples:

Temple 4 has a total of 131 spaces in its 14-level justified graph (Figure 5.42). It has the lowest Space-Link Ratio of all the temples (1.273). The *ubosot* space occupies the last three levels and is isolated from the rest of the graph by layers of three sub-complexes. The first sub-complex (levels 4 to 9) represents the lower terrace and pavilions. The second, the upper terrace (levels 7 to 12) overlaps with the third, the *ubosot*'s terrace (levels 9 to 11). There are two ways to enter the *ubosot*; from the front (space 1) through the gateway (space 49) or from the back of the *ubosot* (space 78) through the series of backstage-like spaces. These two routes require about the same number of steps to reach the prayer hall (space 52).

The most expansive level is on level 7 where most nodes represent the lower terrace space. As in most Thai temples, terrace spaces are the most expansive and can be very complex despite being just open spaces with no physical boundaries. A network of terraces is used to emphasise the enclosed spaces of the *wihans* (spaces 88 and 93), pavilions (e.g. spaces 9 and 15) and the *ubosot*, by raising them up on different heights with the *ubosot* at the highest level. In this way, one becomes involved in at least two sub-complexes of roundabout terrace spaces whenever one tries to reach the centre. Subsequently, there is no real need for the physical barrier such as cloister and thus achieve the concept of simplicity. In this way, Thai temples gain a virtual boundary from the structures of terrace spaces laid one after the other, side by side or on top of one another (Figure 5.43).

The structure from level 4 to the root is very simple because there are only two entrances to the temple complex (spaces 1 and 123) which are directly connected to the terrace space. As in most selected temples, c-type represent more than half of the temple space and constitute about twice as many as d-type spaces. The *ubosot* terrace is the set of spaces that branch out from space 41 at the front entrance while spaces 23 and 78 are the roots of the upper terraces. These spaces are the key spaces of the temple 4's structure while spaces 52 and 63 (the prayer hall) are key spaces for the temple's identity. In other words, c-type and junction-type dominate the structure of temple 4 while d-type and place-type spaces identify it. In this way, it seems that there are properties of architectural space that are dominant in one dimension but may not be so in other dimensions.

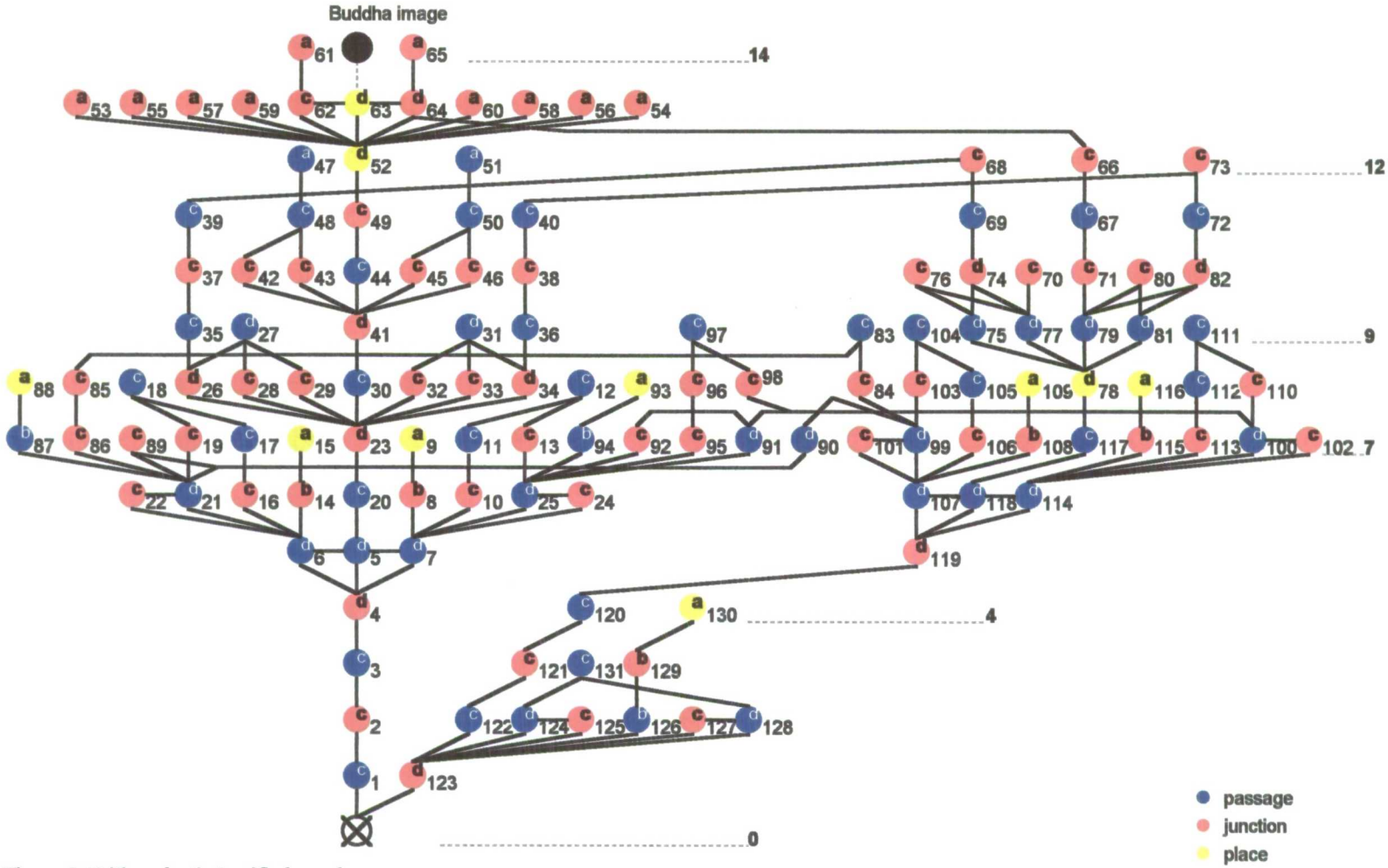
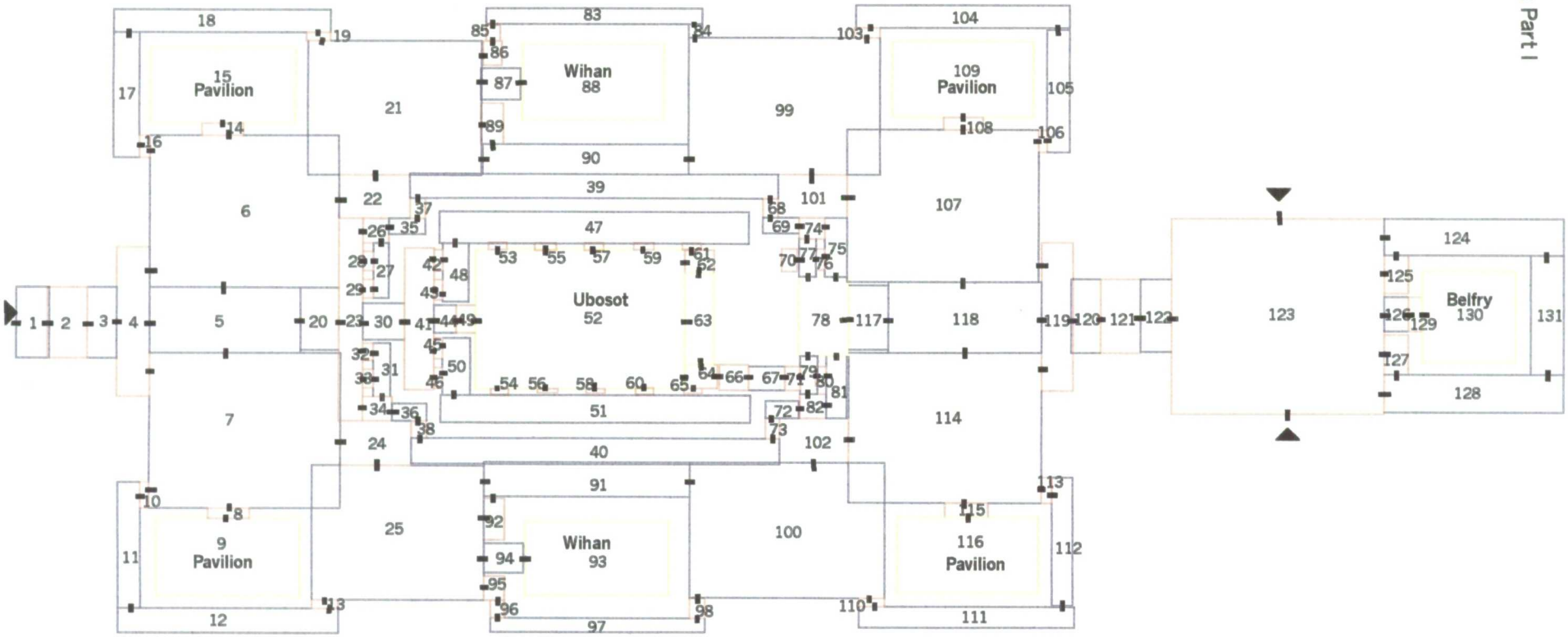


Figure 5.42 Temple 4's Justified-graph
Total space = 131 + 1ext and 167 links, Space-Link Ratio = 1.273



Passage Junction Place

Figure 5.43 Temple 4 Convex space analysis

Temple 5's graph has 19 levels, the deepest among the small temples in the research. The interesting things about the temple's structure are, first, the shallowness of its *ubosot* space from its terrace and, second, the openness of its terrace's structure. The whole structure is constructed symmetrically around the *ubosot* complex (levels 11 to 15). This is the only temple in the research that has no complex structure between the *ubosot* and the exterior space. Instead, the structure opens up and wraps around its inner core (Figure 5.44). In 10 steps one reaches the inner area of the temple (space 25) where worshippers, often remaining outside the *ubosot*, pray to the Buddha image inside the *ubosot*. The prayer hall inside the *ubosot* (space 34) is on level 13 which is similar to the prayer halls of the other small selected temples (level 13 in temple 3 and 12 in temples 4 and 6). However, the structure through which one has to pass to get to the prayer hall in this temple is much less complicatedthan those in other temples.

The most expansive level is level 14 which, unlike any other temples, has already contained many interior spaces of the *ubosot*, including the prayer space (space 76) where people, after assembling in space 34, move on to pray in front of the Buddha image. After finish praying people go out through the side entrances which are short connections between the *ubosot* spaces and the small upper terrace spaces (spaces 55 and 56). In general, terrace spaces here are being laid aside rather than imposed as the barrier as in other temples. On both sides of the *ubosot*, the complexes of spaces 42, 45, 49-56 and 61-66 represent upper terrace spaces wrapped around by the lower terrace spaces. These terrace spaces continue into the deeper levels of the structure and form an independent sub-complex (spaces 104 and 105 on level 12 until spaces 130 and 139 on level 19). As a whole, the structure emphasises and encourages access to its inner core and abandons the traditional idea of isolating the sacred area (Figure 5.45).

Therefore, the terrace spaces seem to be structured for integration as they are the most widespread (levels 6 to 19) and mainly passage-type spaces. There are also some interesting place-type spaces, which are the consequences of two cases. In the first case, experience is created by chance independent from the initial design. For example, spaces 15 and 18 are transformed from typical terrace spaces into prayer spaces by the worshippers who like to pray in these spaces because of their altar-like shapes and locations in front of the sacred statues. This is not the case for similar spaces at the back of the *ubosot* (spaces 97 and 85) which are influenced by design. Belfries (spaces 39 and

48) and prayer spaces (spaces 91, 127 and 133) are included on the terraces as parts of the original design. All of these spaces are conceived based on the place-type experience from the conventional concept of religious functions but in this temple they are loosely defined and very transient, especially to non-worshippers.

These religious-based facilities work in the structure as a-, c- and d-type spaces at the back or on the periphery of the temple, as rings or simply as dead-end spaces in the graph. These unplanned place-type situations are in a few spaces that require no physical definitions showing strong relationship between social activities and architectural space. In temple 5's structural dimension, c-type space is dominant on a global scale at 78 spaces (55%). The proportion of 55 % c- and 29% d-type spaces together with 48% passage- and 45% junction-type spaces of this temple seem to be influenced by its extensive use of terrace to achieve compactness. It is the only temple in the research that has a bigger proportion of passage-type than junction-type which results in the temple's indoor space being well integrated and enveloped by the outdoor space that is very pervasive. In this way, it makes temple 5 a very un-conventional design.

Temple 6's structure is the most minimal in all aspects (Figures 5.46 & 5.47). Its 12-level graph is the shallowest but not the least ringy (1.286 SLR) of all temples. Its structure can be seen as having three parts: 1) the root to level 3, 2) level 4 to 7 and 3) level 8 to 12. The *ubosot* spaces are on the most expansive levels (11 and 12). Temple 6 contains as big a proportion of indoor space (7%) as that of temple 1 which is much bigger. Spaces on levels 10 to 8 are structured to provide segregation between indoor and the terrace space. Similar to the design of temple 5, spaces 19, 32, 33 and 37-39 are parts of the side entrances of the *ubosot* which are the straightforward and shallow structures that lead to the prayer hall of the temple.

Although the most expansive level is on level 12, the most complex part of the structure is in between levels 4 and 7 where there are 43 connections (61% of all connections) and 26 spaces (47% of all spaces). Most of these spaces are terrace spaces. In the absence of cloister spaces, the lower terrace spaces of temple 6 work as the collector of movement in all directions. For example, spaces 4, 26, 44 and 48 seem to be the fulcrum of all movement within the structure (Figure 5.47). The small upper terraces create buffer zones to the *ubosot* space as full size terraces do in the conventional design. The stairs

(spaces 8, 11, 14 and 28-30) and small terrace (spaces 39, 40 and 42) are located between the upper and middle parts of the graph where the terrace spaces work as accelerators squeezing movement into the inner structure.

Spaces 3 and 53 are the origin of movement in religious activities and the orientation points for people who either use the structure as just a building or as a temple. There are not many spaces that are isolated from the main structure or form some distinct sub-complexes since the graph is quite simple. As a result, c-type are fewer than d-type spaces for the first time in all selected temples because simplicity means minimal number of spaces and thus more connections per space. That is why d-type spaces represent about 44% of all spaces while 33% is c-type spaces. However, as in all temples, c-type are more widespread in the structure than d-type spaces. Temple 6's structure has the highest proportion of connecting space at 49% (Table 5.2) which influences the high number of junction-type space at about 51%. The above conditions suggest how to construct a loosely integrated structure which has the experience of an open and minimal space.

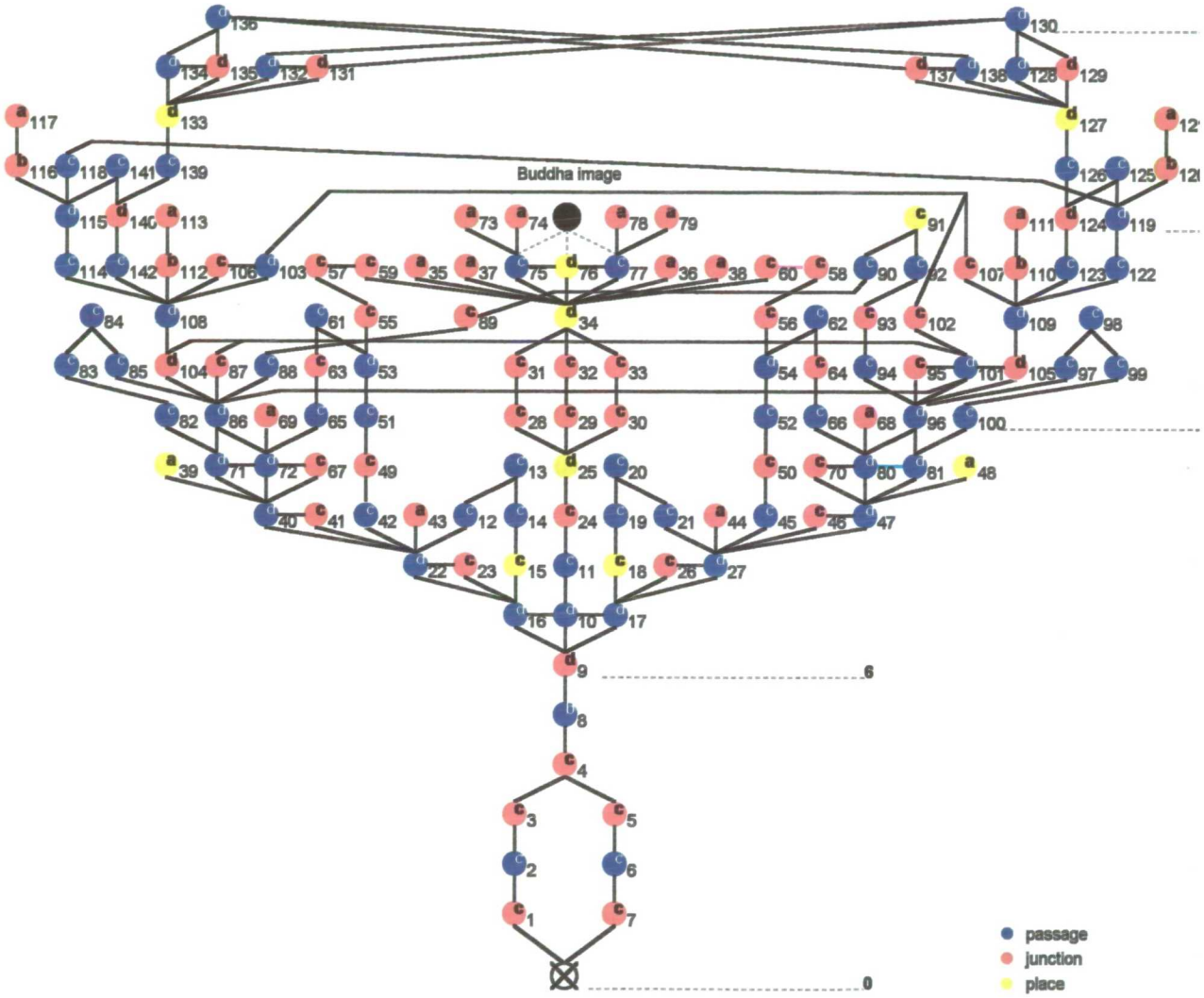


Figure 5.44 Temple 5's Justified-graph
Total space = 142 + 1ext and 189 links, Space-Link Ratio = 1.329

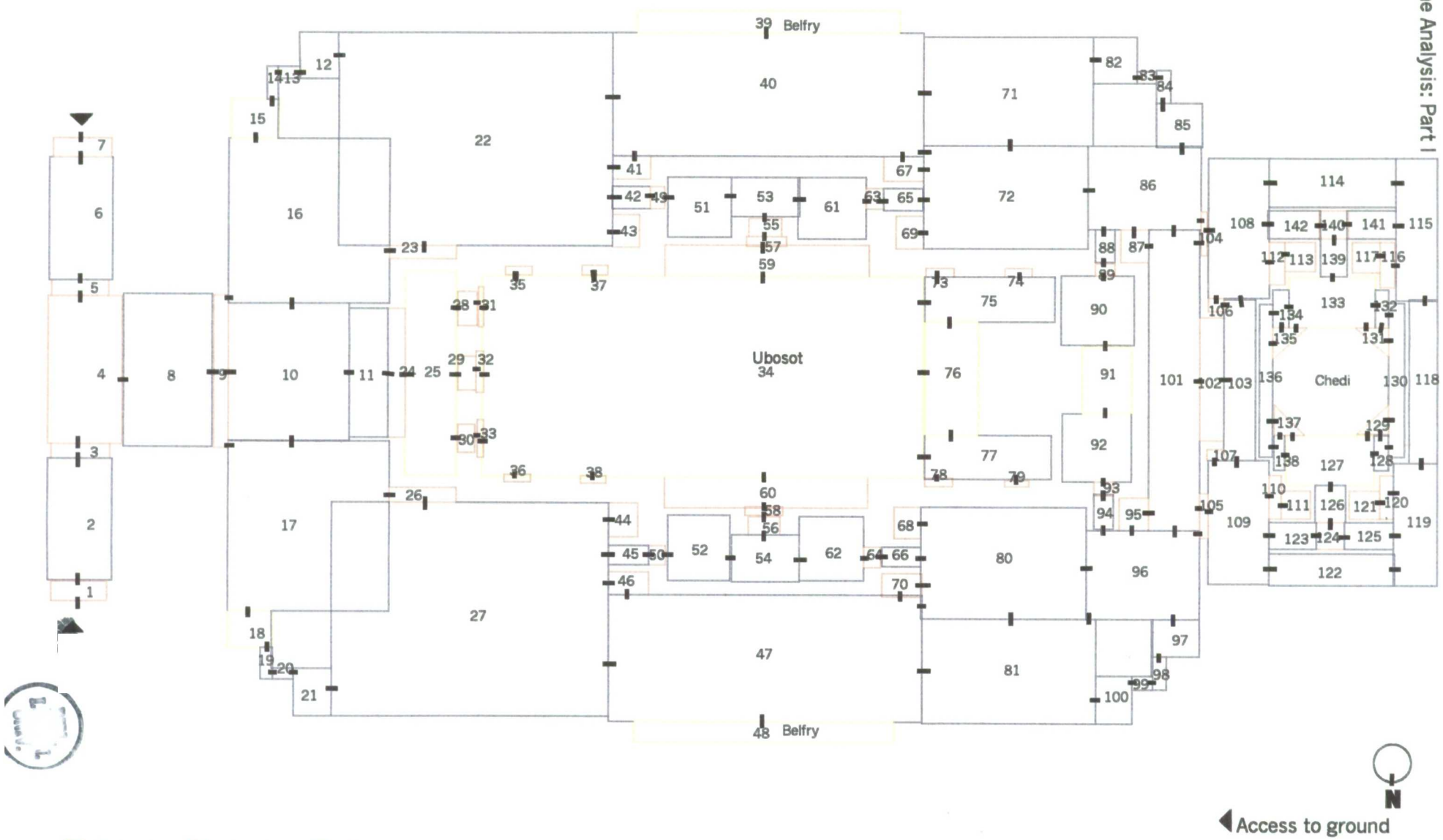


Figure 5.45 Temple 5 Convex space analysis

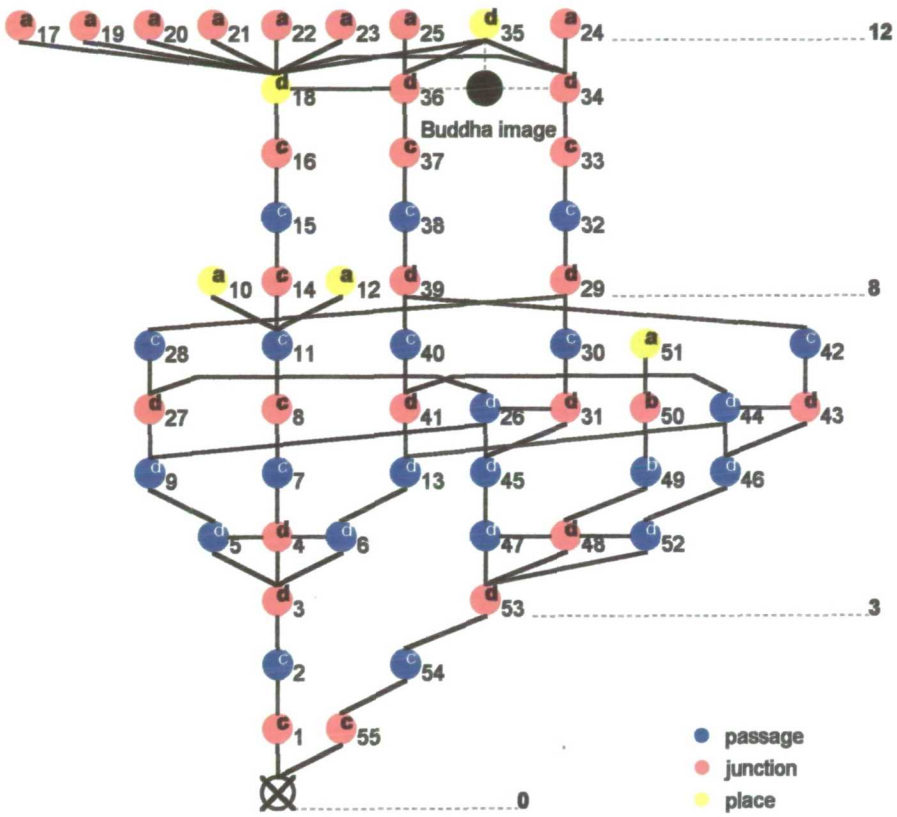


Figure 5.46 Temple 6's Justified-graph
Total space = 55 + 1ext and 71 links, Space-Link Ratio = 1.286

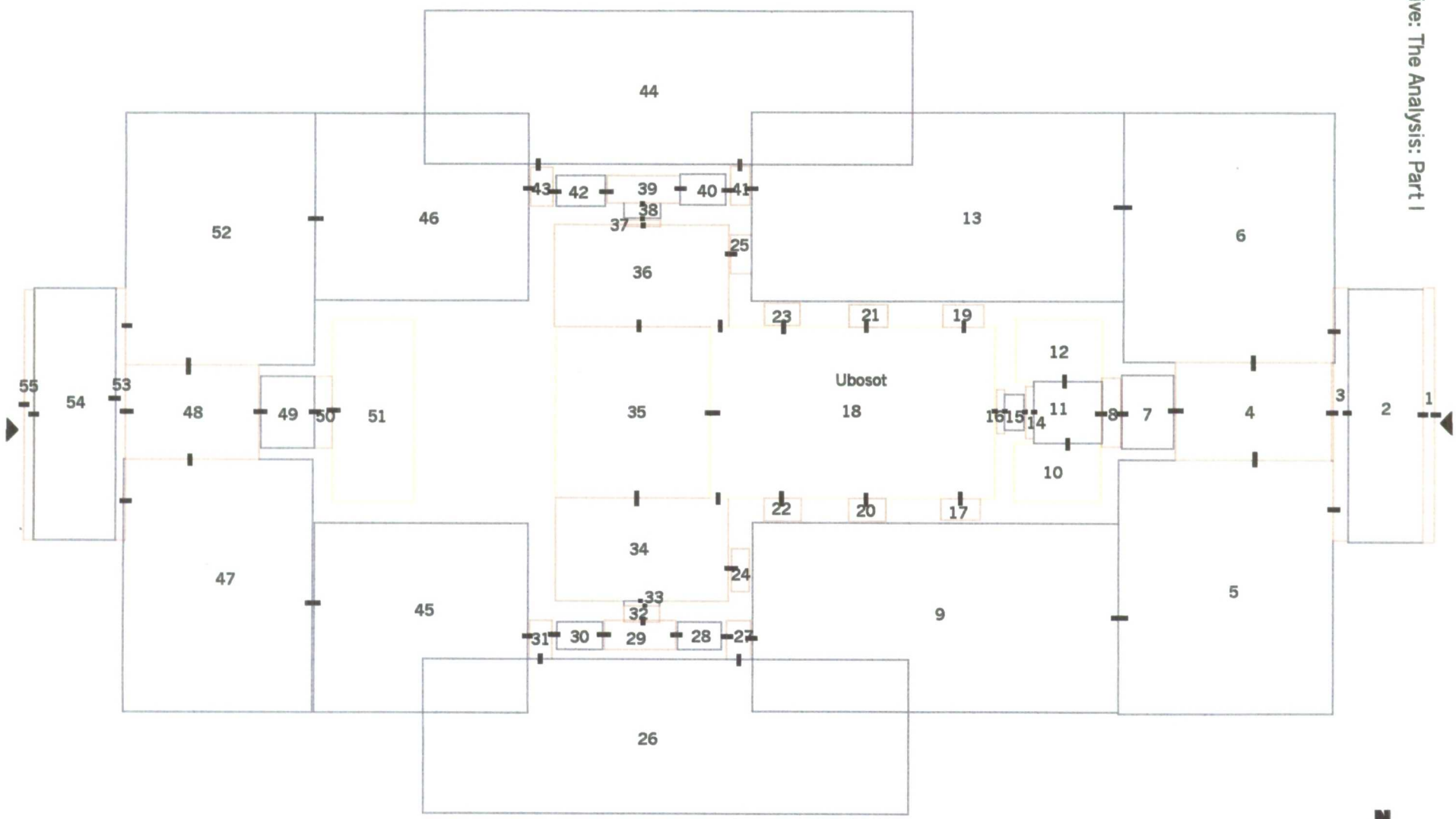


Figure 5.47 Temple 6 Convex space analysis

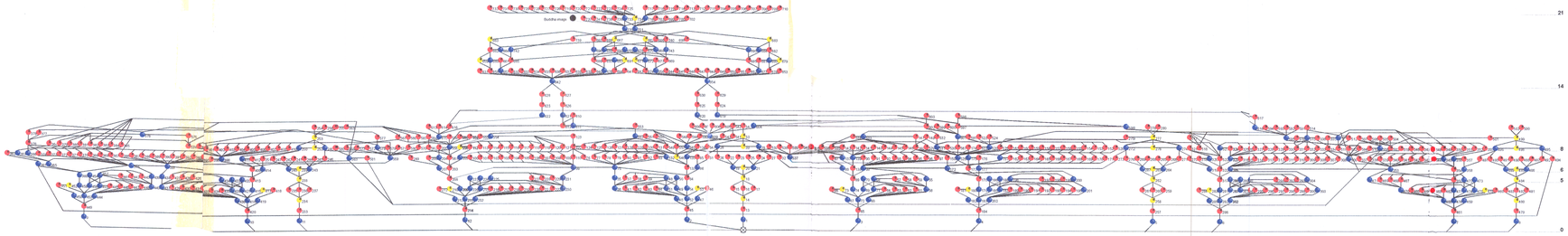
In conclusion, the justified graphs and convex maps reveals some basic properties of space as well as the many ways different structures exist and yet share certain structural similarities common among Thai temples (Figure 5.48). From convex space analysis, the fundamental concepts of *mandala*, east-west axis and successive wave-like design, have very influential roles but are not so clearly presented in graph form as they are in plans. However, some facts are clearer in justified graphs such as the root of every graph, which is usually on the east-west axis, has direct connections with the *ubosot* space. The *ubosot*, or *wihan* in case of temple 2, is always the distinct structure in the graph. Surrounding the *ubosot*, numbers of levels in a graph can often be related to the number of steps taken between the sacred and the exterior space. These are basic features that every structure of the selected temples seems to share. There are also other general points as follows.

Firstly, it is simply clear that temples are deep structures that associate their depth with sacredness and not privacy as in house structures. On average, temple graphs have 16 levels; the deepest is 23 levels in temple 2 and the shallowest is 12 levels in temple 6. The most expansive level is often on level 7 (Temples 1, 3, 4 and 6), temple 2 at level 11 and temple 5 at level 14. The numbers of spaces involved in these levels range from nine in temple 6 to over two hundred spaces in temple 2. The most expansive part of a graph is usually very complex and usually causes adjacent levels to be complex as well. Therefore, as a relatively deep structure, a Thai temple's structure tends to be a complex roundabout unlike Thai house structures which tend to be clear-cut structures of isolated complexes.

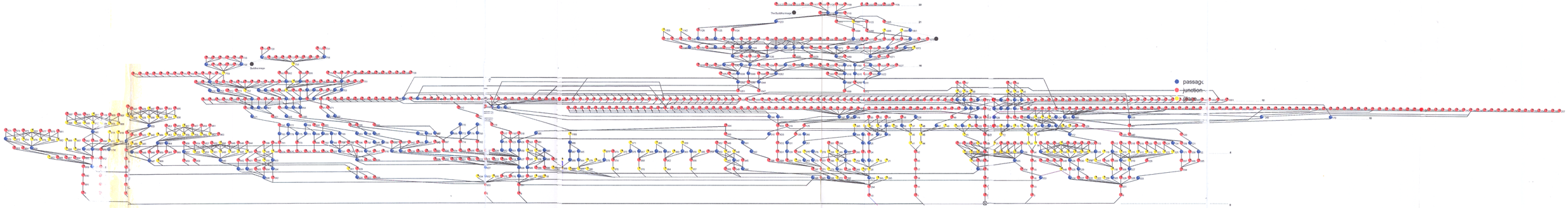
Secondly, temples' structures seem to have three main parts: the inner core, the middle and the root. The inner core is usually the *ubosot* spaces. The middle part usually contains the most expansive and complex part of a structure which usually represents terraces, cloisters and courtyards. The root is usually straightforward but can be fragmented and highly sequential. The deepest inner core is in temple 2's *wihan* having 11 levels while the shallowest temple 6's *ubosot* has only two levels. This part is then linked to the middle area of a graph through only a few spaces. For Thai temples, the use of open space gives the architecture its general characteristics, as in *chan* space of Thai houses. Terraces and cloisters are two architectural elements that define open space in a Thai temple. These two elements create complexity in most selected temples' structures. The average proportion of open space in the selected temples is about 66% while it is 40% in Thai houses. A graph gradually decreases in its complexity when approaching its root which

usually represents the temple's entrances or stairs which are usually simple even though there can be as many as 12 entrances as in temple 1.

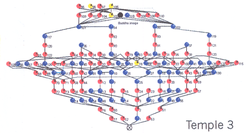
Finally, c-type space is the most dominant type in most temples in terms of number and often in terms of its distribution in graphs. d-type space is often found in the most complex part of a structure and about half of c-type space. On average, a- and b-type spaces represents about 20% in a structure. Temple 3 has the fewest a-type (3 spaces) and none of b-type space while temple 6 has the highest proportion of the combination a- and b-types at 24%. Junction-type is the most dominant experience followed by passage-type space. Place-type space is the most important around which the whole structure is oriented. Temple 3 has the lowest proportion of place-type space (3%) while temple 2 has the highest (15%). The next theoretical analysis will discuss the relations among a-, b-, c-, d-, passage-, junction- and place-type spaces. These properties are the abstraction that is the basis for the understanding of syntactic information, function and architectural elements a space simultaneously contains.



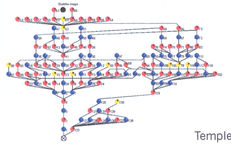
Temple 1



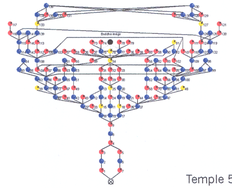
Temple 2



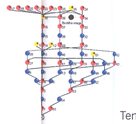
Temple 3



Temple 4



Temple 5



Temple 6

Figure 5.48 Structures of temples 1-6

5.3 Theoretical analysis

Numerical data: Tables 5.7-5.8 (p.256-257)

Graphical data: Figures 5.49-5.121

This analysis focuses on the relations between two abstract properties in the structural and experiential dimensions of architectural space. The selected houses and temples are discussed as the co-present set of twelve examples before returning to individual examples in the next syntactic analysis. Therefore, the number of spaces considered in this analysis will be 340 spaces from the six houses and 2369 spaces from the six temples. These 2709 spaces will be seen as the conceptual relations of ready made architectural space. The analysis will tackle these relations by firstly examining their relations among one another and secondly their roles in a piece of architecture. a-, b-, c- and d-type spaces are space as structural substance (Hillier, 1996) while passage-, junction- and place-type spaces are space as experiential one (Suvanajata, 1994).

Thus, two questions are being asked: how do these two dimensions relate and what effects do they make in a piece of architecture? The analysis uses information from earlier analyses to answer both questions while employing the integration value (taken from every space in the selected examples, see Appendix for the calculation method) to explain additional structural effects of these relations. Theoretically, there are 12 relations that can happen in architectural space:

1) a-passage **2)** a-junction **3)** a-place

4) b-passage **5)** b-junction **6)** b-place

7) c-passage **8)** c-junction **9)** c-place

10) d-passage **11)** d-junction and **12)** d-place.

The following analysis will consider and discuss Thai house and temple spaces based on these 12 structural-experiential relations rather than on building types which are aspects that lie in function-architectural element relations analysed in the next chapter. Specific examples in real situations from the selected examples will be illustrated emphasising the nature of the relation and its effect in architecture.

Traditional Thai houses: **Houses 1 – 6**: Structure-Experience relations														
Relation	H 1-6 (340)		H 1 (35)		H 2 (42)		H 3 (61)		H 4 (91)		H 5 (58)		H 6 (53)	
	No. (%)	Mean int.	No. (%)	Mean int.										
a-passage	-	-	-	-	-	-	-	-	-	-	-	-	-	-
a-junction	-	-	-	-	-	-	-	-	-	-	-	-	-	-
a-place	**89** (**26.2**)	0.695	5 (14.3)	0.649	**9** (21.4)	0.653	**18** (29.5)	0.879	11 (12.1)	0.619	**18** (31)	0.705	**28** (**50.9**)	0.622
b-passage	6 (1.8)	0.783	-	-	-	-	1 (1.6)	1.038	1 (1.1)	0.674	1 (1.7)	0.781	3 (**5.7**)	0.735
b-junction	24 (7.1)	0.783	3 (8.6)	0.844	8 (**19**)	0.929	1 (1.6)	0.872	2 (2.2)	0.590	5 (8.6)	0.830	7 (13.2)	0.597
b-place	11 (3.2)	0.665	-	-	2 (4.8)	0.674	-	-	4 (4.4)	0.554	5 (**8.6**)	0.749	-	-
c-passage	41 (12.1)	0.902	5 (14.7)	0.884	7 (**16.7**)	1.10	7 (11.5)	0.819	6 (6.6)	0.761	8 (13.8)	1.027	8 (15.1)	0.791
c-junction	48 (14.1)	0.844	**9** (**25.7**)	0.813	7 (16.7)	0.888	9 (14.8)	0.957	14 (15.4)	0.732	4 (6.9)	0.908	5 (9.4)	0.900
c-place	18 (5.3)	0.776	7 (**20**)	0.782	1 (2.4)	1.077	-	-	7 (17.7)	0.657	3 (5.2)	0.940	-	-
d-passage	42 (12.4)	**1.208**	3 (8.6)	**0.996**	5 (11.9)	**1.294**	6 (9.8)	1.339	**19** (**20.9**)	0.803	7 (12.1)	1.040	2 (3.8)	**1.129**
d-junction	35 (10.3)	1.044	2 (5.7)	0.946	3 (7.1)	1.123	12 (**18**)	1.267	15 (16.5)	**0.833**	4 (6.9)	**1.066**	-	-
d-place	24 (7.1)	1.020	1 (2.9)	0.763	-	-	7 (11.5)	**1.514**	13 (**14.3**)	0.795	3 (5.2)	0.924	-	-
Total type: 12 (100%)	340	0.860	8 (66.7)		9 (75)		8 (66.7)		**10 (83.3)**		**10 (83.3)**		6 (50)	
Total space = **340** + 6 exterior spaces														

Table 5.7. Structure-Experience relations of Houses 1-6

Traditional Thai temples: **Temples 1 – 6**: Structure-Experience relations														
Relation	T 1-6 (2369)		T 1 (743)		T 2 (1168)		T 3 (130)		T 4 (131)		T 5 (142)		T 6 (55)	
	No. (%)	Mean int.	No. (%)	Mean int.										
a-passage	5 (0.2)	0.481	-	-	3 (0.3)	0.458	-	-	2 (1.5)	0.515	-	-	-	-
a-junction	320 (13.5)	0.544	101 (13.6)	0.671	183 (15.4)	0.553	2 (1.5)	0.540	10 (7.6)	0.556	16 (11.3)	0.586	8 (14.6)	0.618
a-place	54 (2.3)	0.601	-	-	41 (3.5)	0.596	1 (0.8)	0.540	7 (5.3)	0.624	2 (1.4)	0.763	3 (5.5)	0.526
b-passage	9 (0.4)	0.562	-	-	4 (0.3)	0.433	-	-	3 (2.3)	0.687	1 (0.7)	0.738	1 (1.8)	0.526
b-junction	11 (0.5)	0.645	-	-	1 (0.1)	0.389	-	-	5 (5.8)	0.714	4 (2.8)	0.659	1 (1.8)	0.497
b-place	6 (0.5)	0.650	-	-	6 (0.5)	0.650	-	-	-	-	-	-	-	-
c-passage	290 (12.2)	0.669	59 (7.9)	0.791	117 (10)	0.600	35 (26.9)	0.665	28 (21.4)	0.657	40 (28.2)	0.698	11 (20)	0.704
c-junction	976 (41.2)	0.709	335 (45.1)	0.834	502 (42.9)	0.628	55 (42.3)	0.706	43 (32.8)	0.727	35 (24.7)	0.685	7 (12.7)	0.667
c-place	47 (1.9)	0.623	8 (1)	0.780	36 (3.1)	0.582	-	-	-	-	3 (2.1)	0.692	-	-
d-passage	334 (14.1)	0.747	138 (18.6)	0.831	118 (10.1)	0.619	20 (15.4)	0.782	20 (15.3)	0.815	27 (19)	0.788	10 (18.2)	0.765
d-junction	172 (7.3)	0.776	70 (9.4)	0.890	57 (4.9)	0.644	15 (11.5)	0.814	10 (7.6)	0.779	9 (6.3)	0.674	12 (21.8)	0.751
d-place	150 (6.3)	0.600	32 (4.3)	0.709	100 (8.5)	0.589	3 (2.3)	0.687	3 (2.3)	0.689	5 (3.5)	0.568	2 (3.6)	0.734
Total type: 12 (100%)	2369	0.702	7 (58.3)		12 (100)		7 (58.3)		10 (83.3)		10 (83.3)		9 (75)	
Total space = **2369** + 6 exterior spaces														

Table 5.8. Structure-Experience relations of Temples 1-6

1) a-passage type space

Spaces 262, 266 and 1081 in temple 2 (Figures 5.36-5.37) and spaces 47 and 51 in temple 4 (Figures 5.42-5.43) are the only five a-passage type spaces of all 2709 spaces. The concept and architectural situations of this relation are somewhat ambiguous. How can an a-type become a passage-type space? Theoretically, this situation seems impossible since an a-type is the ending space and a passage-type is the from-to space. In temple 2, spaces 262 and 266 are walkways around a pavilion; these spaces are at the end of the walkways thus making them a-type spaces that are also parts of the passage. Space 1081 is originally stairs that leads into the *ubosot* but it has been turned into the backdrop of the small altar on the upper terrace by a change of use. However, this space is occasionally used as stairs in order to get to the altar from inside the *ubosot.* As a result this space is actually used as an a-type for everyday activities while it is read as passage-type space because of its function and appearance (Figure 5.49).

In temple 4, the terrace design creates spaces 47 and 51 which are dead end spaces but they are used as and appear to be passage-type spaces; they are not there to connect one function to another but function as passage (Figure 5.50). In this way, it is the design intention that gives symbolic value to spaces. a-passage relation, therefore, is not functional-oriented. It is usually in a small part of a configuration with low average integration value of 0.481 (Table 5.8). That is why its relation to other spaces is simply annexation most often to the passage-type space. The effect of this relation could be very noticeable in experience but not necessarily well clarified in terms of what it does, especially when read from plans or graphs. This fact seems to explain why we do not find any space with this relation in houses where the economical and functional aspects of space are strictly followed. In fact, it might be that temples employ this relation more than any other kinds of building. In short, a-passage type space is more symbolic than functional and mostly related to passage-type relations.

2) a-junction type space

There is also no a-junction relation in the selected houses but it appears in all selected temples and represents an average 14% of all temple spaces. There are two situations where a-junction type space is created. First is when the terraces of a temple are combinations of big open spaces and small pocket spaces. Second is when there are pocket spaces inside buildings such as spaces between very thick columns and deep inset

window spaces. Clear examples can be seen in both temples 1 and 2 where there are many pocket spaces aligned along the large terrace spaces (Figures 5.33&5.37). There are also some pocket spaces along the very compact terraces of temple 5 (Figure 5.45). The majority of a-junction type space is window space in a thick wall of the *ubosot* or *wihan*. There are no window spaces in temple 3 but there are two a-junction type spaces (spaces 95 and 97) which work as buffer for the altar-like space 96 in the *ubosot* (Figure 5.51).

Theoretically, a-junction relation seems to be ambiguous making its concept more symbolic than functional and always has the buffer effect that works between two spaces. These two spaces are often in different zones and thus do not have physical connections between them but need symbolic connections that recognise the differences in terms of spaces and zones. For example, spaces between the rows of columns next to the altar in temple 1 (e.g. spaces 711-713 and 719-721) are not the physical but visual linkages between the hallways and the sacred altar (Figure 5.52). It is the same for window space which is the symbolic connection to the space beyond the *ubosot* (Figure 5.53). Physically, these a-junction type spaces are transient in both use and movement which is why it is experienced as junction-type space in the first place. Its integration value is generally in the low tier (the average of 0.544) but higher than a-passage. a-junction in the selected Thai temples tends to connect to passage-type spaces. It can be in the space that has a high symbolic value at a cost of physical connections; in other words, it is a virtual relation between movement and function.

3) a-place type space

This relation is one of the most stable relations, especially in house architecture. From table 5.7, a-place is often the relation that has the highest number of space in all relations in the selected Thai houses. However, a-place is only a small portion in the selected Thai temple (2%). The concepts of the pair are very compatible; that is, a-type represents the destination of movement while place-type space represents the conclusion of one sequence of movement. In houses, a-place type is usually in enclosed spaces that have notions of being rooms for specific functions. However, there are many spaces on *chan* space, in the courtyard, on the terrace or in parts of the *ubosot* that are a-place type spaces. These spaces have the relation from social activities that happen in them. For example, space 40 in house 2, spaces 39 and 48 in temple 5 or spaces 10, 12 and 51 in temple 6 (Figures 5.54-5.56) are open spaces that are used as a-place relation.

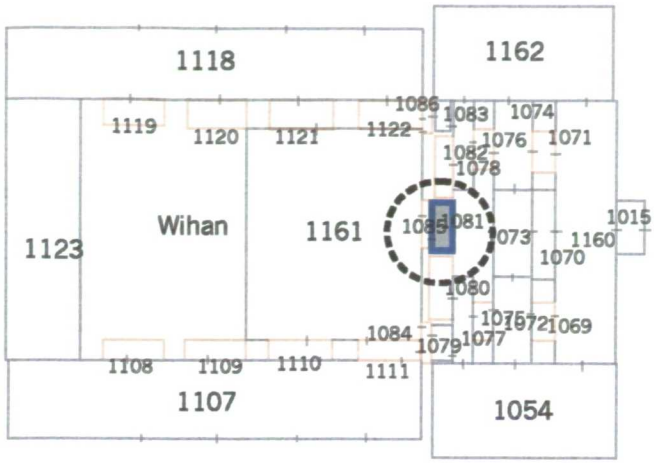


Figure 5.49 Stairs-altar, space 1081, temple 2

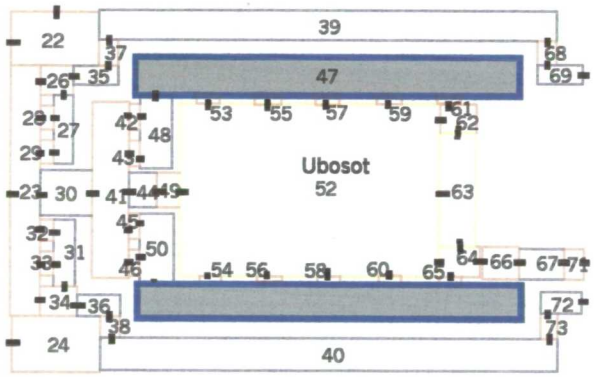


Figure 5.50 Spaces 41 and 51, temple 4

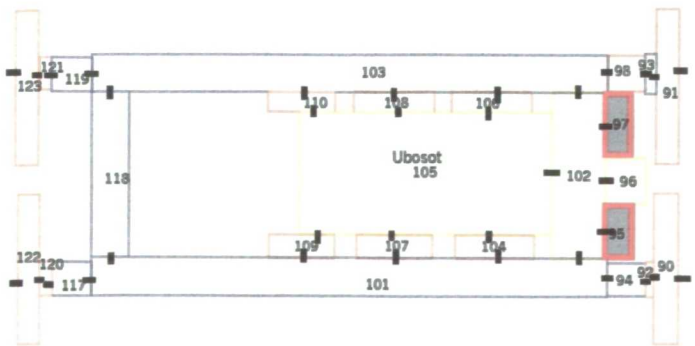


Figure 5.51 Spaces 95 and 97, temple 3

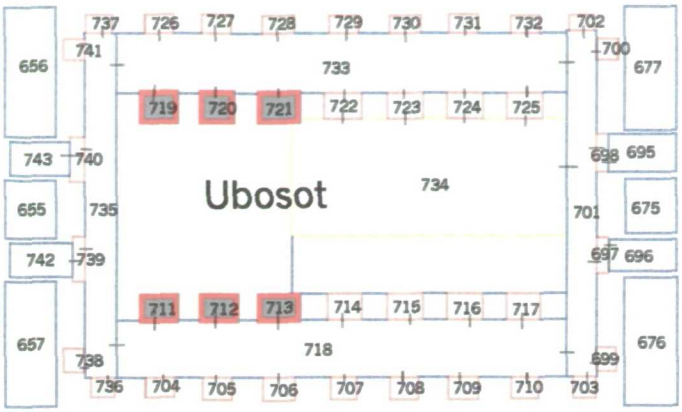


Figure 5.52 Spaces 711-713 and 719-721, temple 1

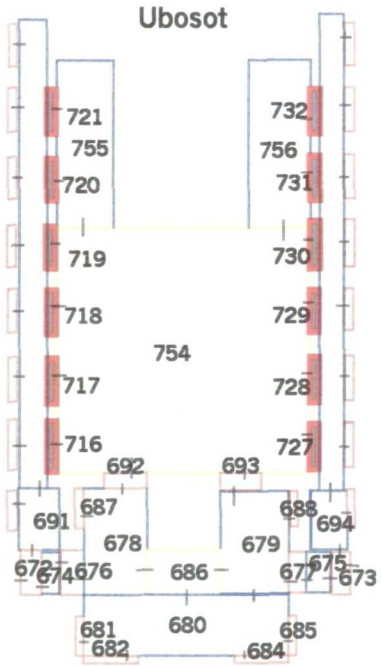
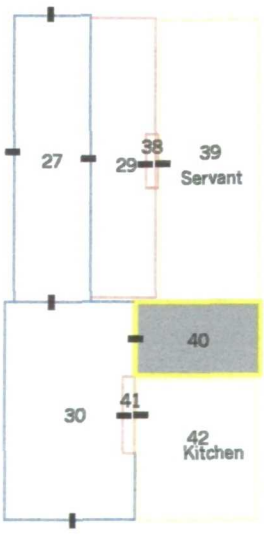


Figure 5.53 Window spaces, temple 2



Passage Junction Place

Figure 5.54 Space 40, house 2

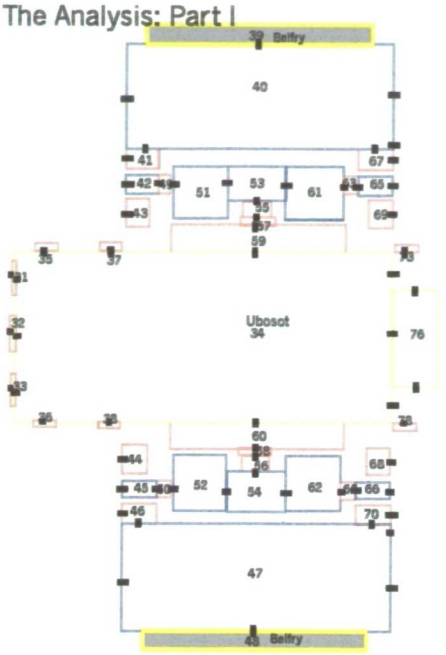


Figure 5.55 Spaces 39 and 48, temple 5's belfries

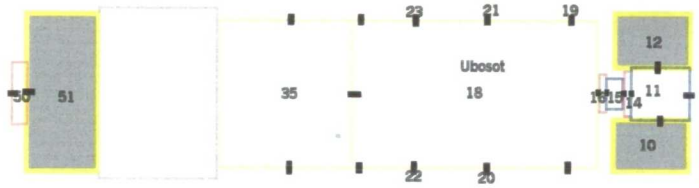
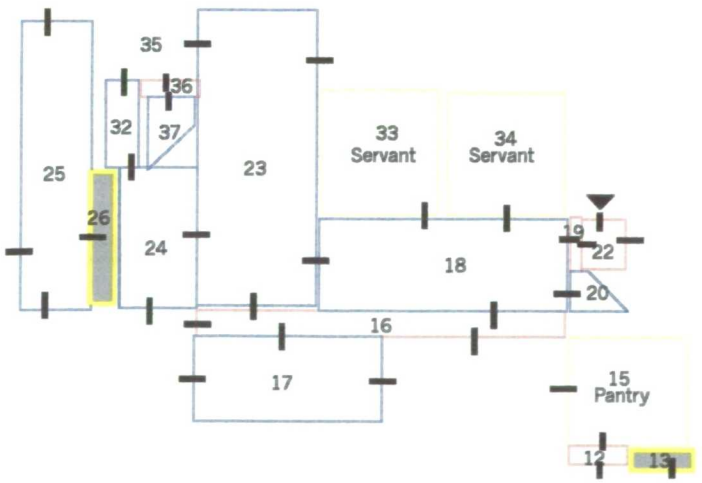


Figure 5.56 Spaces 10, 12 and 51, temple 6



Passage Junction Place

Figure 5.57 Spaces 13 and 26, house 4

Spaces 13 and 26 in house 4 and spaces 18, 21, 23 in temple 2 are examples of how spaces are differentiated from the big open space through real activities (Figures 5.57-5.58). These spaces are turned into places for sitting down, preparing food in house 4 and rest area in courtyards of temple 2. Space 96 in temple 3 is another interesting example of the relation created by social activities that permanently turn the unused stairs into prayer space (Figure 5.59). The proportion of a-place type space in Thai temples is much lower than in houses (3% and 26%, respectively). This is because Thai temple spaces and structures are not designed to achieve privacy but sacredness which suggests public congregation. Furthermore, many a-place type spaces are created by chance not by design or rules especially in *chan* spaces of houses. Its integration value is on average higher in the selected Thai houses (0.695) than in temples (0.601). At this stage, it seems that a-place is a very stable relation especially in houses where all the a-type spaces are place-type.

4) b-passage type space

This relation is in only six spaces in the selected Thai houses and nine spaces in temples. Theoretically, the concepts of these two properties seem similar because they both represent the 'to and from' movement. However, this relation is not prevalent in Thai houses and temples. A general theoretical reason for this is that the passage-type has a wider implication and a bigger scale of 'to and from' movement in terms of bodily movement than b-type space. Therefore, as well as considering the structural nature of 'leading to the dead end' in b-type space, this relation is rather exclusive to a very heavily partitioned space such as western-oriented designs. The architectural reason for the lack of this relation in the selected examples is because of the open-space oriented design of Thai architecture which discourages segregated spatial structures through minimum use of erected partitions.

An interesting example is space 8 in temple 5 which has the highest integration value of all the spaces in this relation at 0.783 (Figure 5.60). It also seems to play an important structural role in the temple because of the unusual situation since a Thai temple normally has more than one entrance from exterior space (Figure 5.44). b-passage type space in temple 5 then assumes a very important link at a global scale. Other examples have smaller scale impacts which seem to be usual for the relation. b-passage type space almost always relates to, apart from a-type and place-type, other b-type spaces on the

upper levels in the graph. An exception is found in temple 2, all b-passage type (spaces 755-758) are connected to a-junction type spaces at the furthest point of the graph (Figure 5.61). In most cases (e.g. spaces 12, 20 and 21 in house 6 or spaces 87, 94 and 126 in temple 4), b-passage type space is very independent and is often isolated in the structure (Figures 5.62-5.63). In short, b-passage type space seems to be very segregated but could be the key space to various sub-complexes and further expansion.

5) b-junction type space

This relation appears in all the selected Thai houses but in only four temples. This relation is strong in Thai houses since their zonings are often divided by volumetric differences. Doorways to sleeping units are often emphasised by big steps so that there are level changes when one goes in or out of the room, e.g. spaces 11 and 12 in house 1 and spaces 21 and 22 in house 2 (Figures 5.64-5.65). b-junction type spaces are all on terrace space in temple 4 where the relation is in the small spaces between open and indoor spaces. Spaces 8, 14, 108, 115 and 129 are b-junction type spaces in temple 4 which are there by design as well as space 50 in temple 6 (Figures 5.66-5.67). Spaces 110, 112, 116 and 120 in temple 5 and space 1085 in temple 2 do not serve any particular purpose except being junctions (Figures 5.68-5.69). Sometimes verandas work as b-junction type spaces to provide extra steps before reaching the indoor space, e.g. spaces 19 and 20 in house 2 or spaces 14, 35 and 40 in house 5 (Figures 5.70-5.71).

b-junction relation is more localised in terms of bodily movement and structure than that of b-passage. b-type space suggests in general a structure of ending a movement or leading to the end while junction-type space suggests movement of being 'in between' and not 'to-from' like in passage-type. Therefore, the pair releases a notion of joint between only two functions or movements. In Thai houses and temples, the relation is often between passage- and place-type spaces and has higher mean integration value in house spaces than in temple spaces (0.783 and 0.645, respectively). Considering both the numbers and structural quality of the relation, it seems that b-junction is more significant in Thai houses than in temples. As mentioned earlier, houses are structured around privacy and thus b-junction relation may contribute to such a quality. Like b-passage, this relation creates segregation and, unlike b-passage, it forms a close knit sub-system rather than an isolated sub-structure.

Figure 5.58 Spaces 18, 21 and 23, temple 2

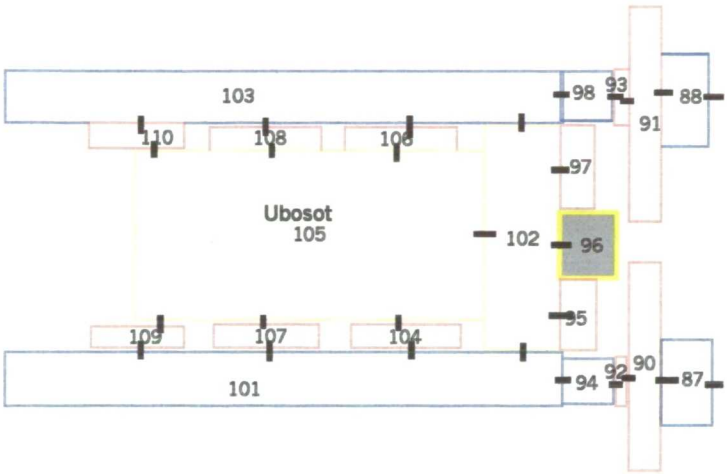
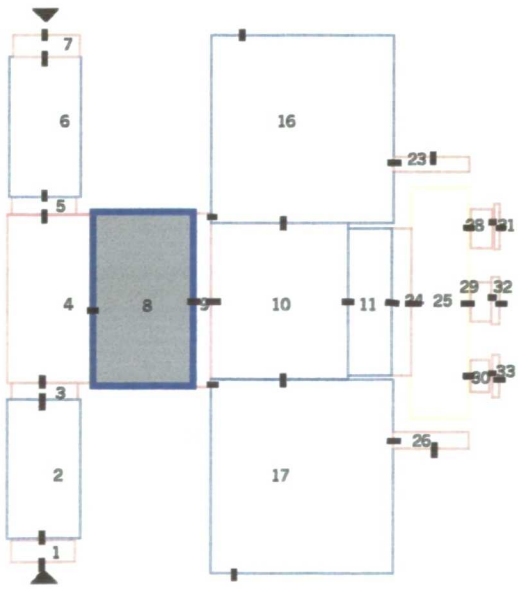


Figure 5.59 Space 96, temple 3



Passage Junction Place

Figure 5.60 Space 8, temple 5

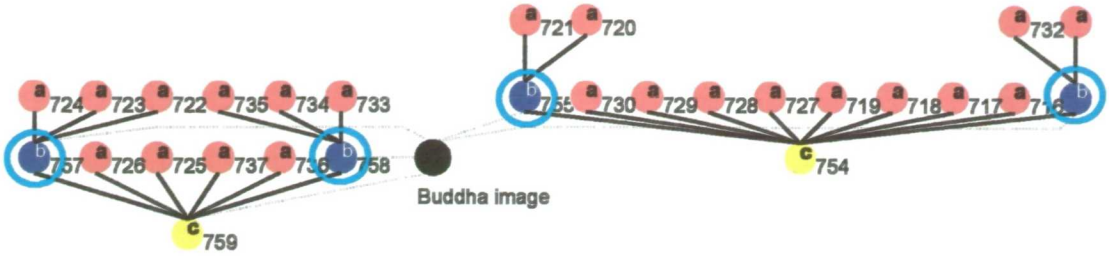


Figure 5.61 Spaces 755-758, temple 2

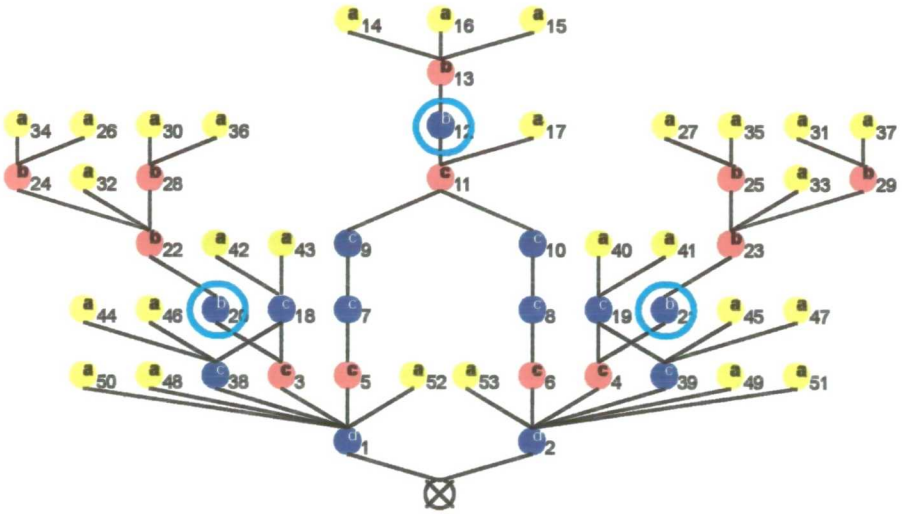
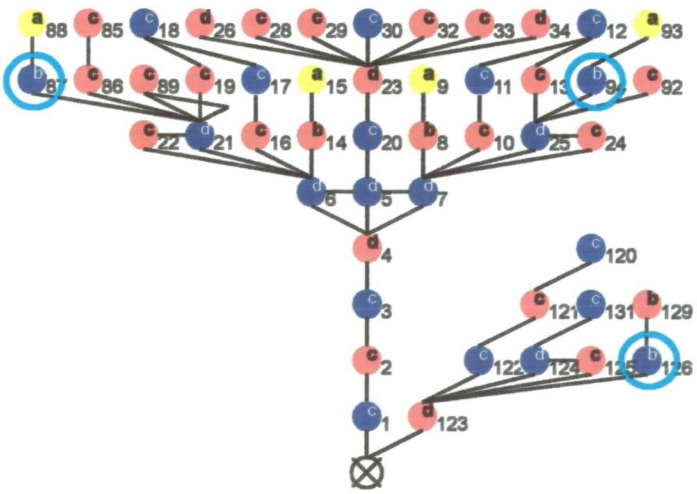


Figure 5.62 Spaces 12, 20 and 21, house 6



Passage Junction Place

Figure 5.63 Spaces 87, 94 and 126, temple 4

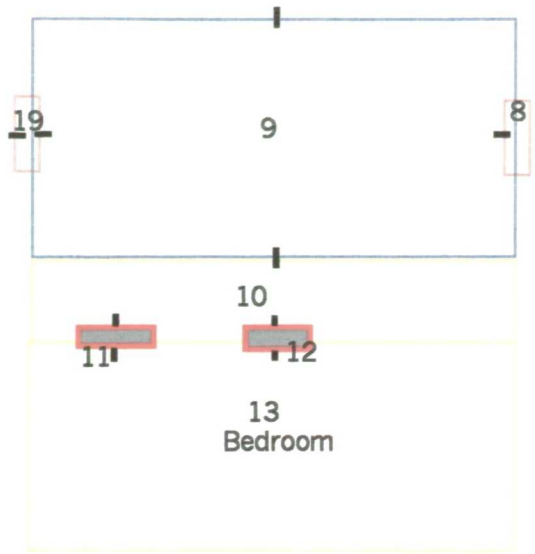


Figure 5.64 Spaces 11 and 12, house 1

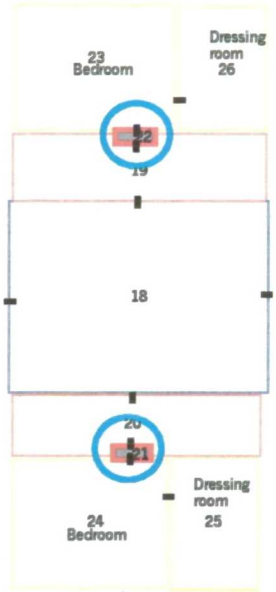
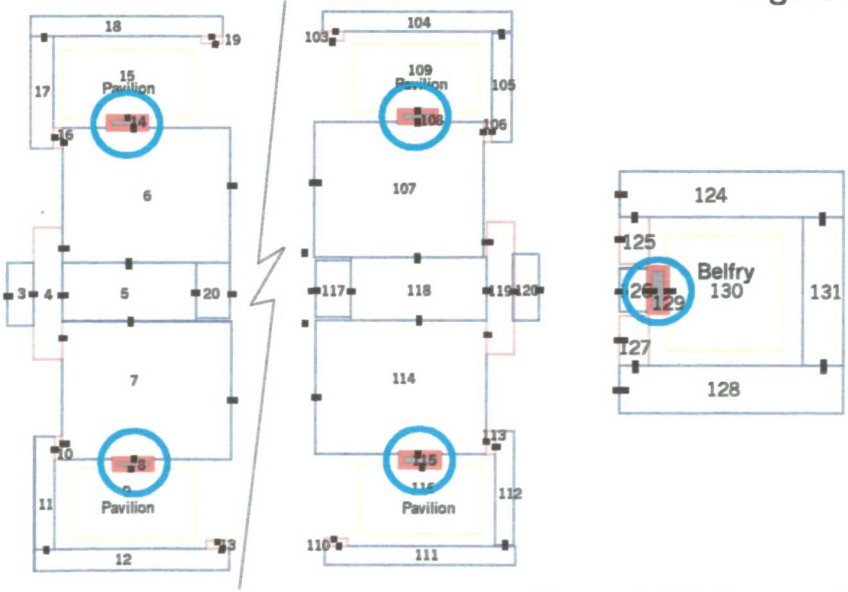


Figure 5.65 Spaces 21 and 22, house 2



Passage Junction Place

Figure 5.66 Spaces 8, 14, 108, 115 and 129, temple 4

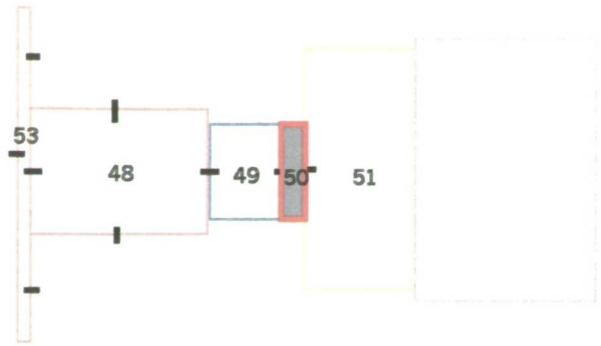


Figure 5.67 Space 50, temple 6

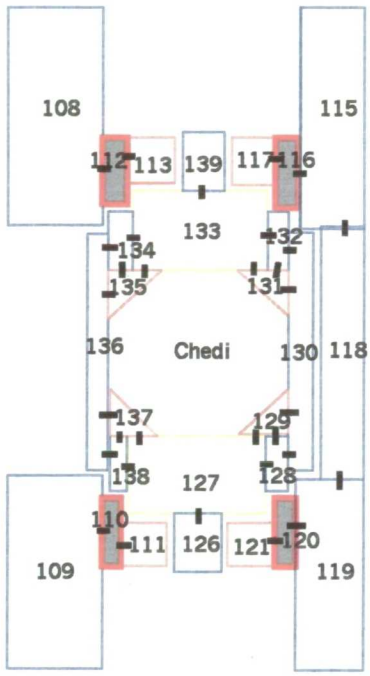


Figure 5.68 Spaces 110, 112, 116 and 120, temple 5

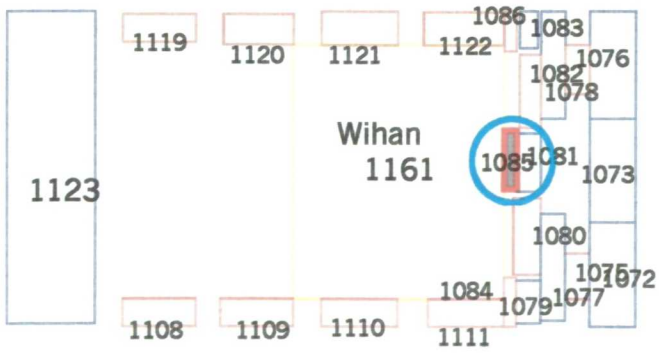


Figure 5.69 Space 1085, temple 2

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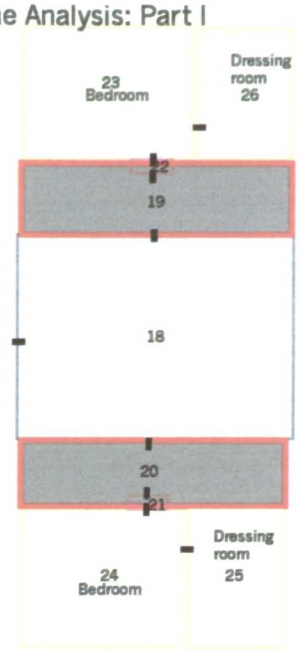

Figure 5.70 Space 19 and 20, house 2

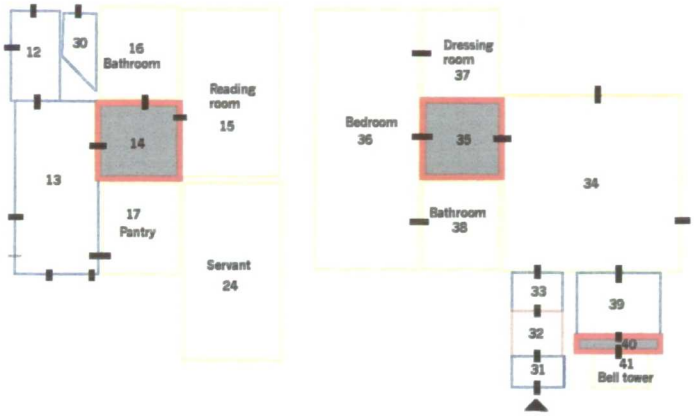

Figure 5.71 Spaces 14, 35 and 40, house 5

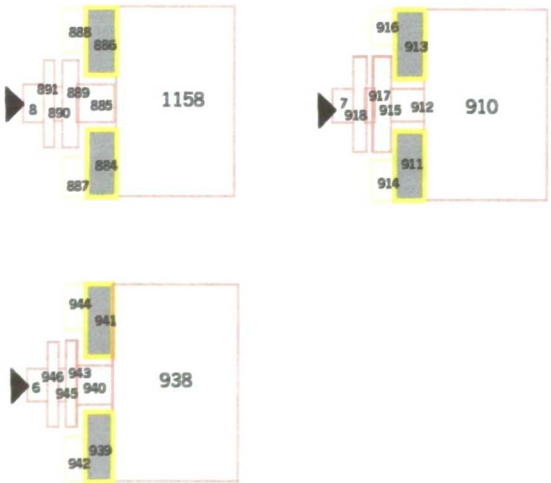

Figure 5.72 Spaces 884, 886, 911, 913, 939 and 941, temple 2

Passage Junction Place

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6) b-place type space

The relation is again much more common in Thai houses than in temples. In houses, b-place is in 11 spaces, more than b-passage (6) but less than b-junction type spaces (26). If we consider the nature of the relation, it is clear that it has some contradictions in it and yet it appears in three out of six houses (but only in one temple) this could be accidental or a special design characteristic or both. It could also mean just accidents for temple space since there are only six spaces from 2369 spaces. Spaces 884, 886, 911, 913, 939 and 941 are b-place spaces in the courtyards by the entrances 6, 7 and 8 in temple 2 (Figure 5.72). The situation is when pocket spaces are created and further sectioned into rooms by activities not design suggesting either a different way of occupying space or a specific way of moving through space. However, the static occupation of space does not always imply the end of movement but the micro scale of movement inside such a space. The research acknowledges the existence of this micro scale system but does not cover it. However, it will be presented later as a topic for further research.

In Thai houses, the relation is obviously created by design. b-place type spaces in houses 2, 4 and 5 are often the most important spaces such as bedroom complexes, e.g. spaces 23 and 24 in house 2 or spaces 28 and 29 in house 4 (Figures 5.73-5.74). The relation is also in the house's terraces and verandas, e.g. space 51 in house 4 and space 43 in house 5 (Figures 5.75-5.76). These spaces are always followed by a-place relations and are usually at the deepest end of a structure. Therefore, b-place forms a sub-complex which is more integrated in itself than b-junction type relation resulting in the relation's average mean integration value (0.65) being higher than the b-junction's (0.645). In conclusion, despite its difference in theoretical concept, b-place relation can be created by design and offers special characteristics in space that have mostly been employed in the indoor spaces of Thai houses. The relation is much less usual in temple architecture and it is created more by chance than design.

7) c-passage type space

This relation seems to constitute a considerable proportion in small size temples representing about 20% in space of temple 6 and up to 28% in space of temple 5. In temples 1 and 2 only up to 10% of the spaces are c-passage relation. The proportion of c-passage is more consistent in the selected Thai houses. c-passage relation is used to achieve a 'from-to' relationship in spaces that have more choices and destinations. The

theoretical concepts of c- and passage-type space are quite compatible because their purpose is mainly for circulation however, c-type space can be a part of only one ring of a complete circle of movement in a part of a structure while passage-type space does not necessarily suggest so. Moreover, a passage-type suggests the highest exposure to various movements and structures comparing to junction- and place-type spaces.

It seems that c-passage is structured in such a way that it has to be confined around the nature of c-type space and, in a lesser degree, vice versa. This results in spaces of this relation are usually created to serve particular intentions in design. For example, in house 6, with the highest proportion of this relation, spaces 38 and 39 are underpasses below the veranda spaces of monks' units. They work as alternative routes that branch out from the backbone of the structure therefore the coexistence of other complexes is allowed. Theoretically, it seems that the need for privacy exploits c-passage type, especially in house architecture. In Thai houses, this relation is also used in the open spaces to provide a mild segregation through 'from-to' structure. More than 50% of c-passage type spaces in the selected Thai houses are stairs spaces used to separate the complex from exterior space, e.g. spaces 2, 27, 32 and 35 in house 1 (Figure 5.77). c-passage space 9 in house 1 and space 18 in house 2 provide privacy to the sleeping units (Figures 5.78-5.79).

In Thai temples, the role of c-passage type space is theoretically similar to that in houses. Temple 5 has the highest number of this space (40), which are mostly in the open space creating segregation for sacredness (Figure 5.80). Other selected temples make use of the c-passage type relation in the same way except temple 1 with the least proportion of this relation (8%). Only very few c-passage type spaces are interior spaces in all temples. As a passage-type, the space often tends to deal with the junction-type in both houses and temples. As a whole, the relation produces a much higher mean integration value when it is in houses than in temples (0.902 and 0.669, respectively). In short, c-passage type spaces are mainly in open spaces and support the many parts that coexist in a structure which otherwise might be in conflict.

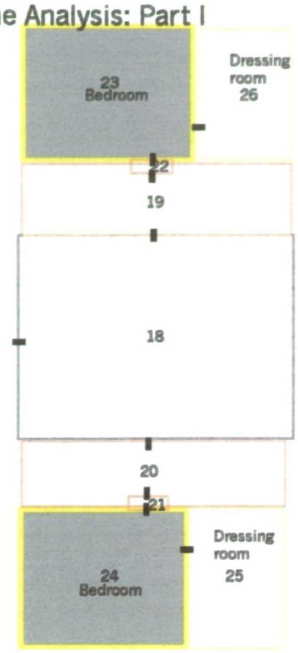


Figure 5.73 Spaces 23 and 24, house 2

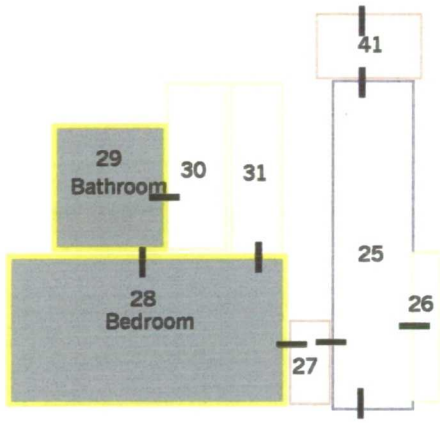
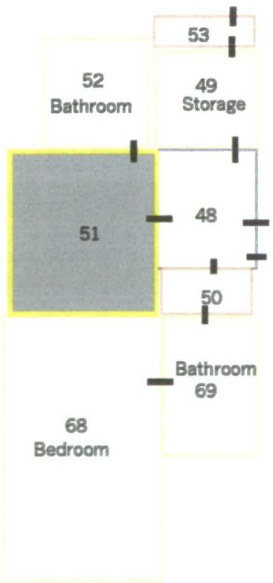


Figure 5.74 Spaces 28 and 29, house 4



Passage Junction Place

Figure 5.75 Space 51, house 4

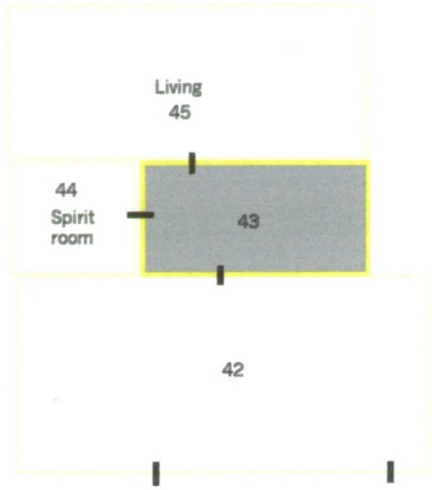


Figure 5.76 Space 43, house 5

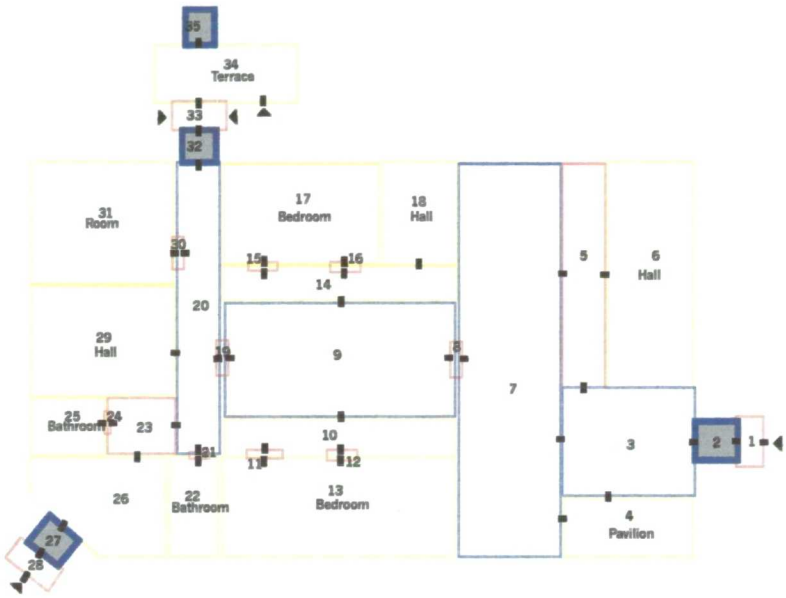
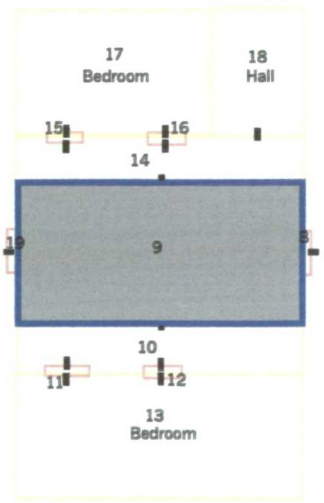


Figure 5.77 Spaces 2, 27, 32 and 35, house 1



Passage Junction Place

Figure 5.78 Space 9, house 1

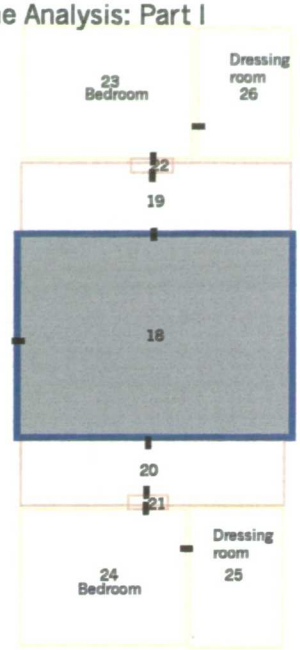


Figure 5.79 Space 18, house 2

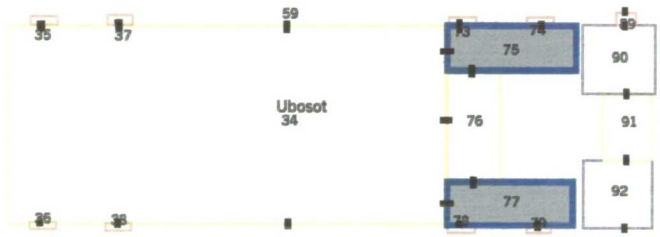
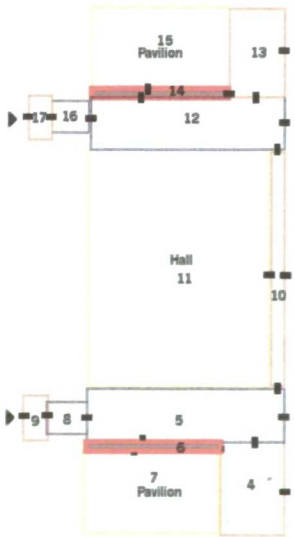


Figure 5.80 Spaces 75 and 77, temple 5



Passage Junction Place

Figure 5.81 Spaces 6 and 14, house 2

8) c-junction type space

This relation has the largest population in the selected Thai temples (40%) but the second largest in houses (14%). Large amounts of c-junction type space are in cloister spaces of temples 1 and 2. In theory, this relation is one of the most compatible types because c-type involves movement that is less expansive than the one in passage-type and less localised than the one in place-type space. c-junction relation creates a situation that is common in Thai houses where there are steps that define different zones. Spaces 6 and 14 in house 2, spaces 23, 54 and 57 in house 3, spaces 41 and 50 in house 4 or spaces 5 and 6 in house 6 separate spaces in detail (Figures 5.81-5.84). Spaces 1 and 28 in house 1, spaces 1, 9, 17, 32 and 37 in house 2, spaces 1, 2, 3 and 32 in house 3 and spaces 1, 2, 14 and 22 in house 4 globally link the complex to exterior space (Figures 5.85-5.88).

The relation represents a considerable proportion in most selected houses, except in house 5 and 6 (Table 5.7). In temples, the proportion of c-junction type spaces is orderly decreasing from temple 1 at about 45% to about 13% in temple 6 (Table 5.8). This situation is mainly the result of the temples having cloister spaces in their architecture. Movement through a structure seems to be more fragmented when passing through this local-oriented c-junction relation than in a passage- or place-type. Consequently, the relation slows down movement as well as internally separating major parts of a building. In a small and minimal temple such as temple 6, this relation is diminished along with the conventional sense of transition. Spaces 1, 33, 37 and 55 in temple 6 work in a similar way as c-junction type spaces in houses which signify different zones with steps (Figure 5.89). It is interesting to further observe the effect of c-junction type space in relation to how temple architecture exploits this structure to achieve sacredness.

The relation's proportion is more consistent in houses than in temples has higher mean integration value (0.844 and 0.709, respectively). This suggests that the relation is more evenly distributed and closely integrated in houses' structures than in temples'. The relation often connects major areas in both Thai houses and temples and forms sub-complexes in those areas. Thai houses and temples similarly use this relation to segregate either privacy or sacredness from the rest of the structure and exterior space. As a result, there are clear structures from the outside to the main body of all justified graphs as well as a clear separation of their inner parts using c-junction type spaces.

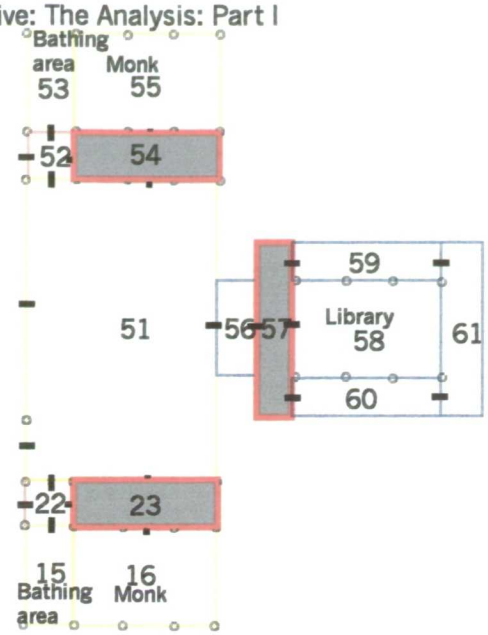


Figure 5.82 Spaces 23, 54 and 57, house 3

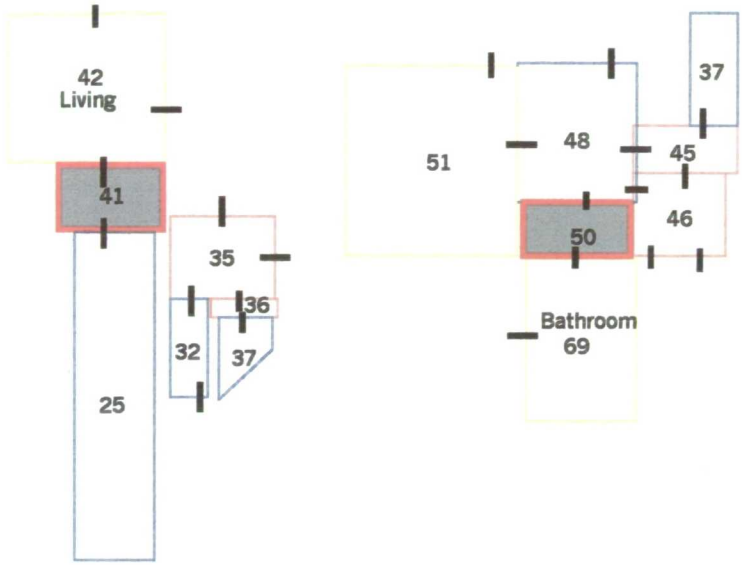
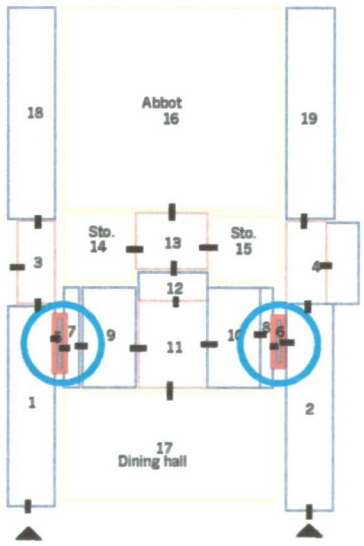


Figure 5.83 spaces 41 and 50, house 4



Passage Junction Place

Figure 5.84 Spaces 5 and 6, house 6

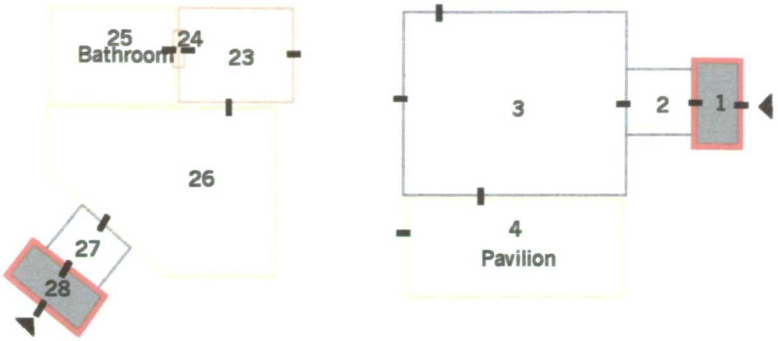


Figure 5.85 Spaces 1 and 28, house 1

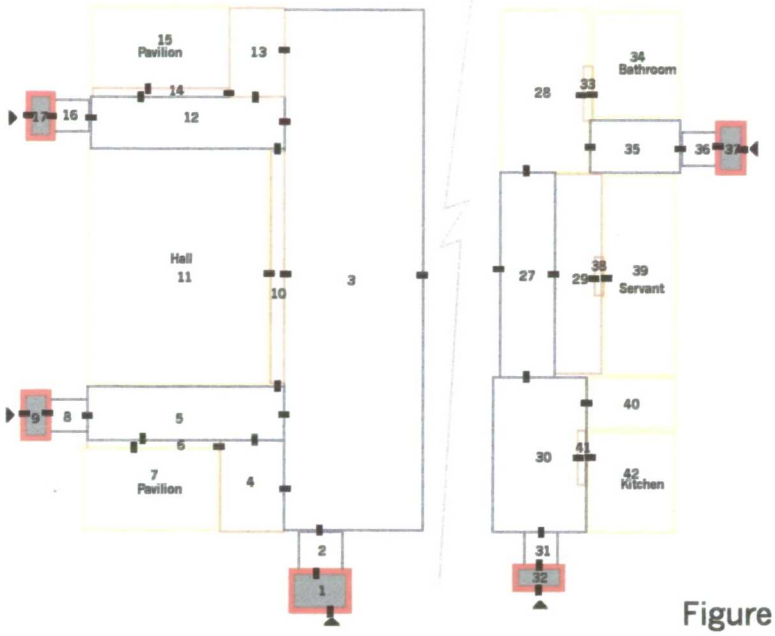


Figure 5.86 Spaces 1, 9, 17, 32 and 37, house 2

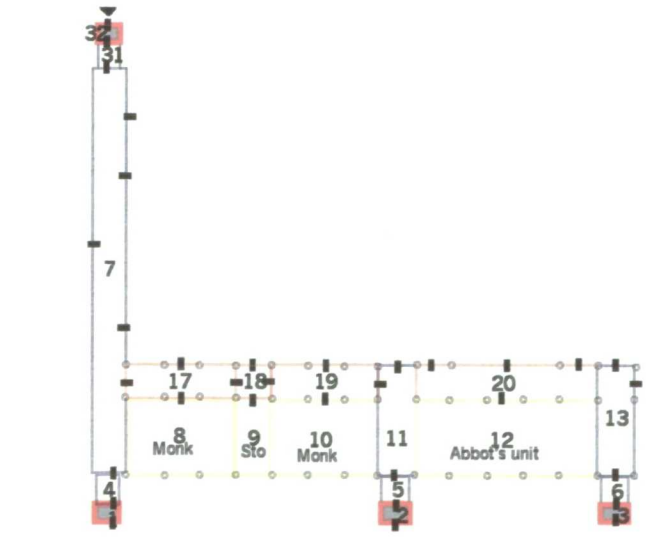


Figure 5.87 Spaces 1, 2, 3 and 32, house 3

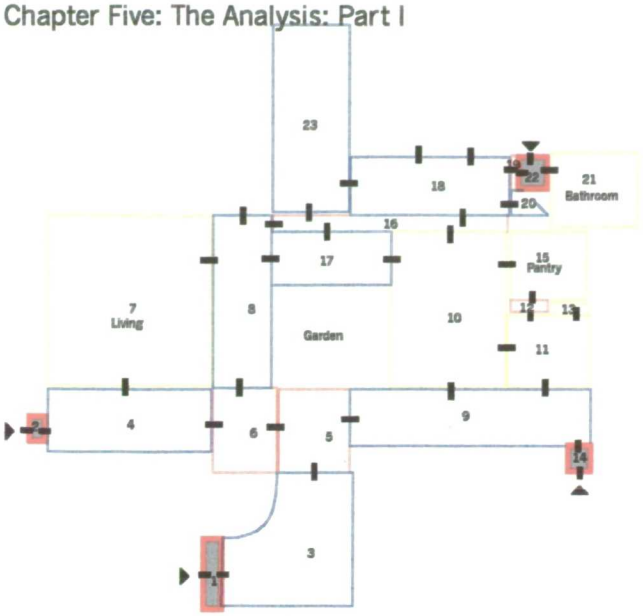


Figure 5.88 Spaces 1, 2, 14 and 22, house 4

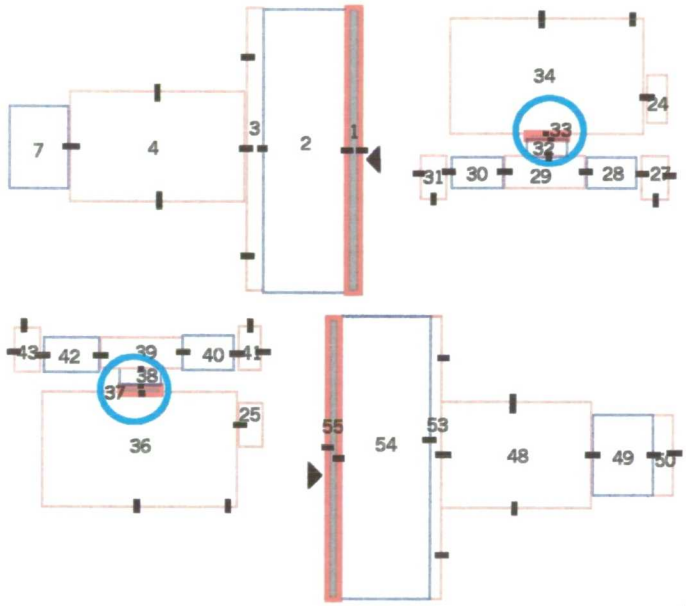
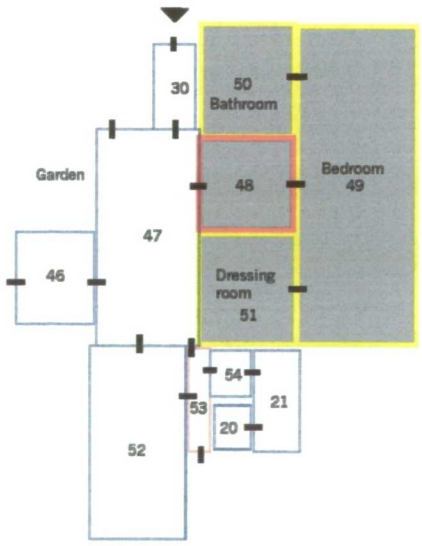


Figure 5.89 Spaces 1, 33, 37 and 55, temple 6



Passage Junction Place

Figure 5.90 Spaces 48-51, house 5

9) c-place type space

Four houses and three temples have c-place type spaces. The relation is an interesting combination because it deals with the sense of place in a more dynamic way than in a- or b-type spaces. In combinations which have theoretical contradiction like b- or c- versus place-type space, the causes and effects can be more by chance than by design. But it can also mean that it is a special way that gives the architecture its character. However, to determine this fact, further investigations in other dimensions in architectural space must accompany the theoretical proposal, as we shall see later on. In this case, there are seven out of 12 buildings that employ this relation suggesting towards the use of the relation as intention in design. For example, there are interior spaces with c-place relation that achieve more open-ended structure in bedroom, dressing room and bathroom, e.g. spaces 48-51 in house 5 and spaces 61, 62, 68 and 69 in house 4 (Figures 5.90-5.91).

In the selected Thai houses, nine out of the total 18 spaces of this relation are open spaces while some are partially enclosed spaces on *chan* spaces, for example spaces 4, 10 and 14 in house 1 and space 15 in house 4 (Figures 5.92-5.93). These spaces have the properties of c-type spaces that create local segregation but they also have the properties of place-type space that unite spaces by being hubs of activities. Place-type spaces attract many spaces around them experientially and, in a less obvious way, structurally. 44 out of 47 c-place type spaces are in temples 1 and 2. Temple 5 has only three c-place type spaces but they are quite important (Figure 5.94). Space 91 is a prayer space created by design while spaces 15 and 18 are also prayer spaces but are created by real activities.

In temple 1, there are very few c-place type spaces created by everyday uses such as spaces 53 and 73. They are differentiated by the strong routes of passage created by everyday movement (Figure 5.95). In temple 2, only a few spaces of this relation are designed, e.g. spaces 754, 759, 1065, 1066, 1142 and 1153 (Figure 5.96). In short, c-place relation is less common in Thai temples than it is in houses where double requirements of accessibility and privacy are needed. The relation is often intentionally designed in house spaces but less so in temples'. c-place are often in more important locations in houses' structures than in temples' reflecting in a higher average integration value of the relation (0.776 and 0.623, respectively). As a whole, c-place seems to play an integrating role and tends to encourage more place- and d-type spaces.

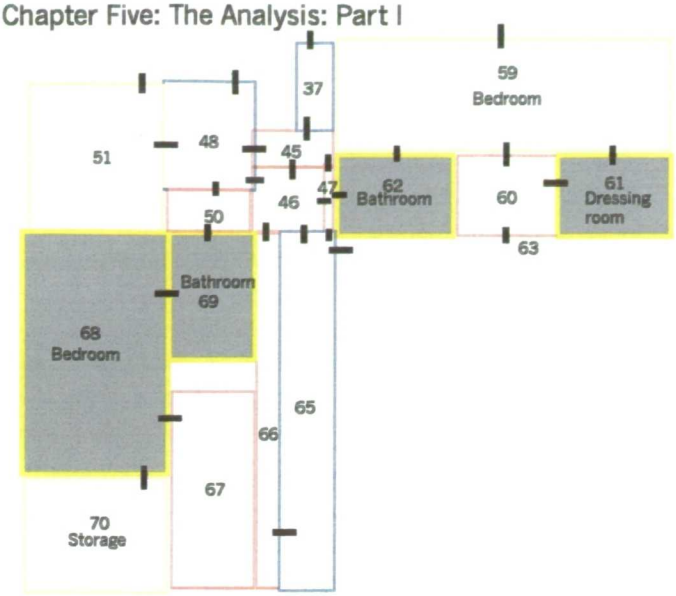


Figure 5.91 Spaces 61, 62, 68 and 69, house 4

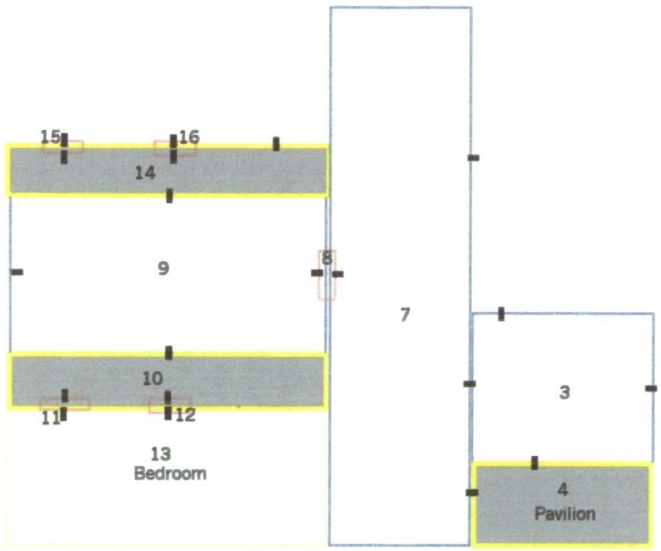
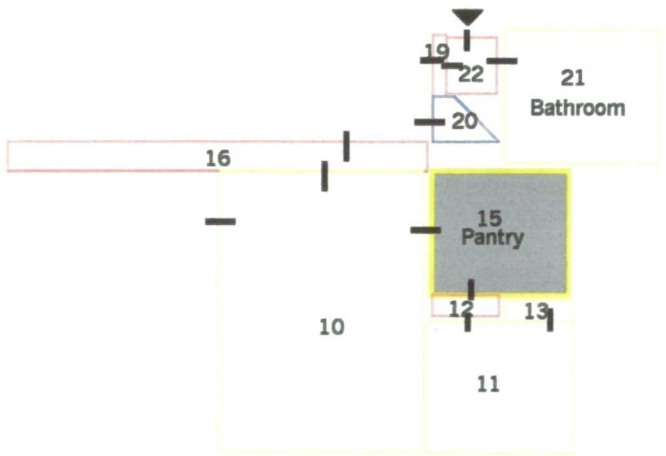


Figure 5.92 Spaces 4, 10 and 14, house 1



Passage Junction Place

Figure 5.93 Space 15, house 4

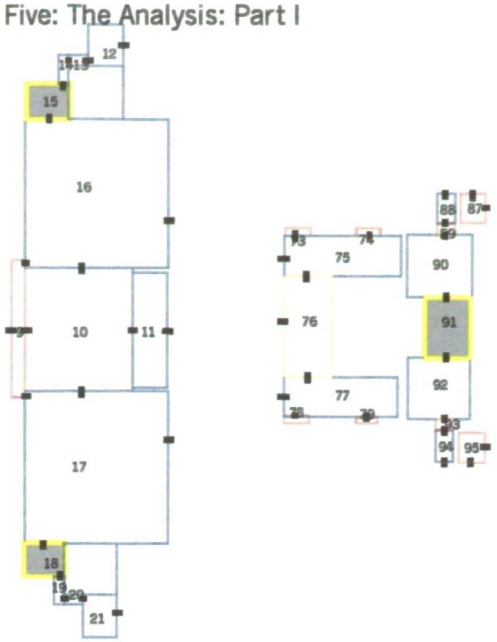


Figure 5.94 Spaces 15, 18 and 91, temple 5

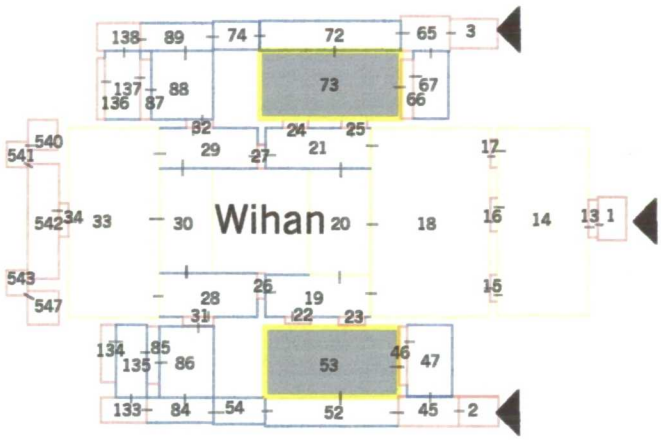


Figure 5.95 Spaces 53 and 73, temple 1

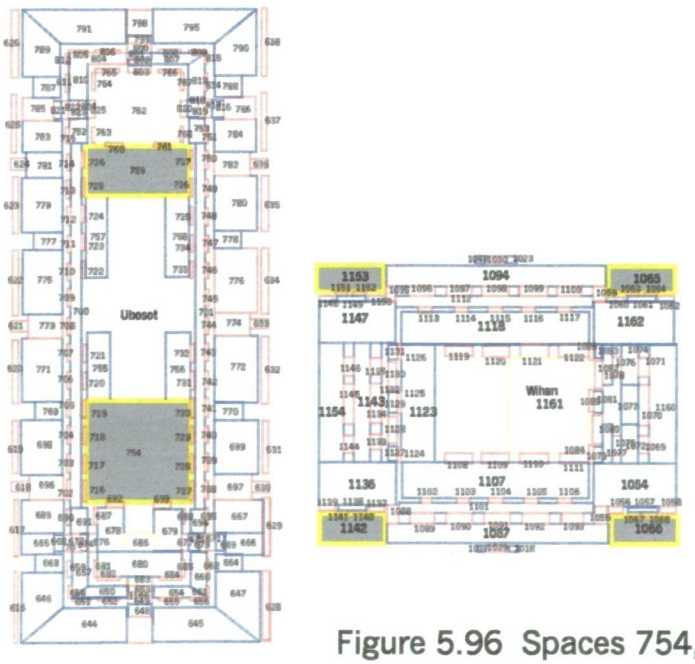


Figure 5.96 Spaces 754, 759, 1065, 1066, 1142 and 1153, temple 2

Passage Junction Place

10) d-passage type space

This relation is one of the strongest in terms of numbers of space. It is the second largest in temples and the third largest in houses (334 (14%) and 42 (12%) spaces, respectively). Of all 2709 spaces, d-passage type spaces represent about 14% less than only c-junction type spaces (35%). d- and passage-type are very compatible in their concepts because both of them involve with large scale movement and structure. This is particularly strong in Thai temple architecture where there are some spaces that manage a large number of spaces. Good examples are in temples 1 and 2 such as spaces 111 or 151 in temple 1 and spaces 228 or 969 in temple 2 are as very powerful in terms of structure as d-type and provide an expansive experience as passage type spaces (Figures 5.97-5.98). However, temple 5 has the biggest proportion of d-passage type space (19%) followed by temple 1 (18%) while temple 2 has the smallest proportion (10%).

The relation is usually found in spaces that play very constructive roles in the most complex parts of a structure. Theoretical notions of the pair support each other very strongly suggesting that the relation is quite stable. It could also mean that the relation happens very easily in the process of making a building therefore it may be conceived by chance. However, the good ones are likely to be the products of design as seen in temples 1 and 2. Design that involves a lot of open space as in Thai architecture seems to encourage the appearance of d-passage type spaces. In temple 5, there are many examples of this space because of the fragmented spaces on its terrace. Even though temple 5 has the biggest proportion of this space in its structure, the quality is not the highest. This relation is meant to be the generator or the accelerator that drives the movement around the whole building.

In Thai houses, the proportion of d-passage type space increases when the complexity of the house increases. House 4 has the highest number of space of all houses and also has the biggest proportion of d-passage type space (21%). Spaces 23 and 64 in house 4 play very important roles in the house's open space (Figure 5.99). Other examples are spaces 7 and 20 in house 1, spaces 3 and 27 in house 2, or spaces 3 and 47 in house 5; they all are at very crucial points of the structures (Figures 5.100-5.102). The most compact house 6 has the least number of this relation at 2 spaces (4%). The relation represents the highest mean integration value in four houses and three temples resulting in its average integration value in houses (1.208) being much higher than in temples (0.746). However,

the proportion of d-passage type spaces is much more consistent in temples than in houses due to the consistency of complexity of temple space (Tables 5.7-5.8). The relation connects to every kind of relation and appears at almost every level in Thai houses' and temples' structures. In conclusion, the relation assumes the most important structural role and provides very expansive experience.

11) d-junction type space

This relation is very often directly connected to d-passage type or c-junction type space. It is the fourth largest type in the selected temples' spaces, 172 spaces (7%), and a fifth of houses' spaces, 35 spaces (10%). Theoretically, d-junction is different from d-passage type spaces in that d-passage usually deals with many more spaces and thus with one or more systems while d-junction plays a connecting role in a smaller scale. d-junction seems to be in the connection of two or more d-passage type spaces and their sub-complexes. It is different from c-junction in separating sub-complexes because d-junction type integrates. Spaces 43 and 45 in house 3, spaces 16 and 46 in house 4 and spaces 7 and 19 in house 5 all deal with integration tasks (Figure 5.103-5.105). This fact is even stronger in Thai temple architecture where there are many more sub-complexes formed in complete isolation from one another. This is because of the need to establish self-referential points, especially in a large, complex temple, thus enhancing the sense of sacredness through the sequencing of many systems.

The *ubosot* of a temple tends to be isolated from the rest by channelling movement through only a few spaces. Such spaces are often d-junction type spaces that play a very important connecting role. It can be seen as the integrator that sweeps up all movement from d-passage type spaces and deliver them to the next accelerator. In this way, the need for d-junction spaces is much smaller than for c-junction type spaces, which play a similar role but in a more local and internal way. In large temples, there are very good examples of d-junction type spaces such as spaces 1009, 1012, 1047 and 1051 in temple 2 (Figure 5.106) working as the exclusive integrators between the inner and outer parts of the temple. This relation is also found in spaces that connect the movement of one system to another. For example, spaces 137, 341, 304 and 511 in temple 2 (Figure 5.107) are very crucial on a large scale but it becomes so through small joints between systems.

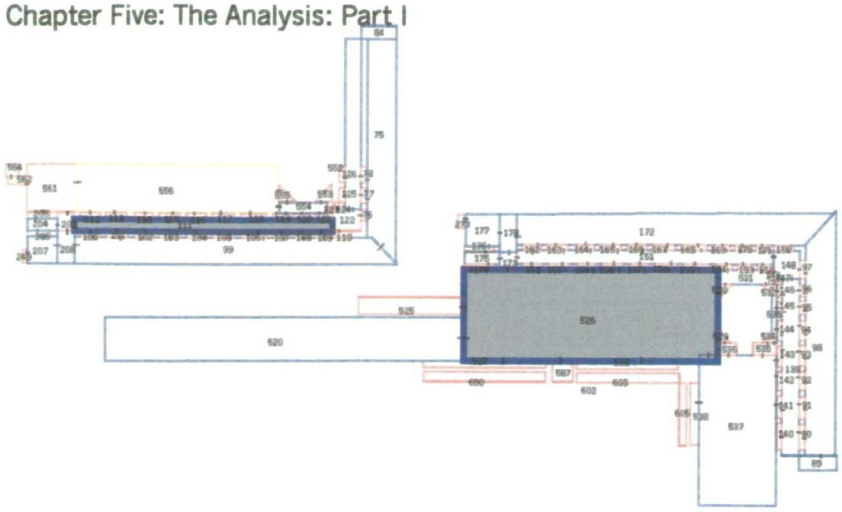


Figure 5.97 Spaces 111 and 526, temple 1

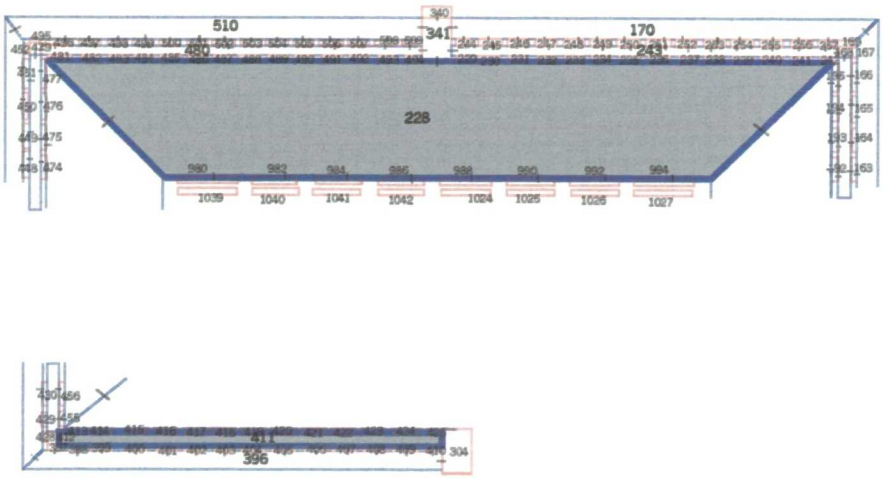
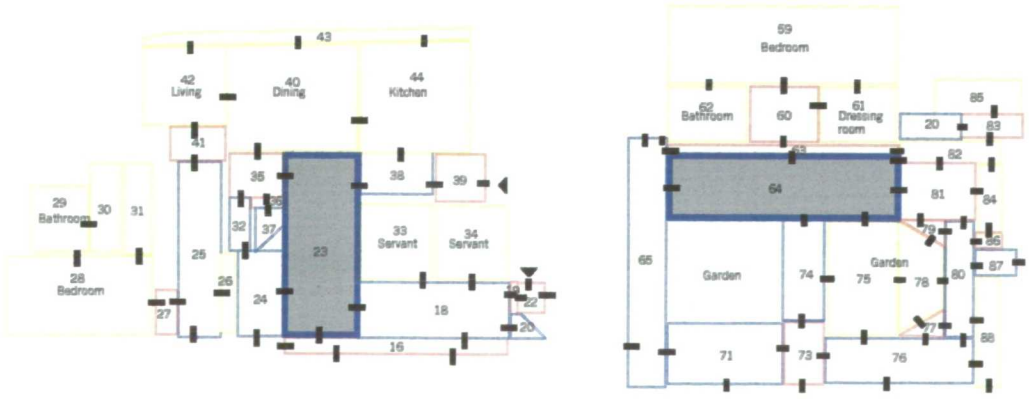


Figure 5.98 Spaces 228 and 411, temple 2



Passage Junction Place

Figure 5.99 Spaces 23 and 64, house 4

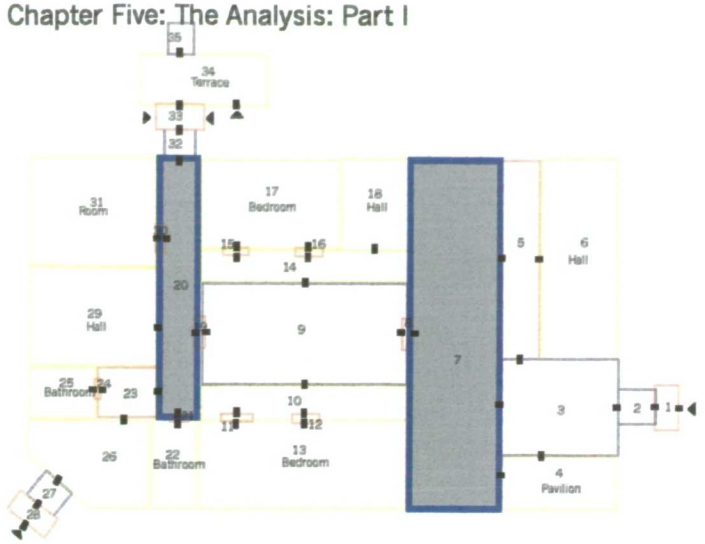


Figure 5.100 Spaces 7 and 20, house 1

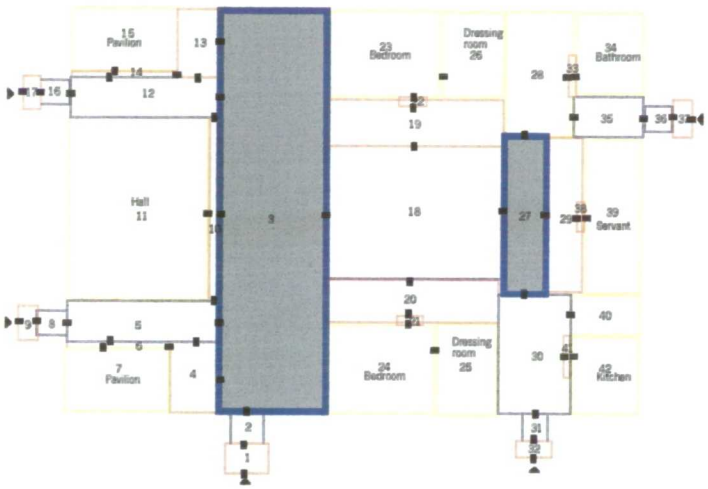


Figure 5.101 Spaces 3 and 27, house 2

Passage Junction Place

Figure 5.102 Spaces 3 and 47, house 5

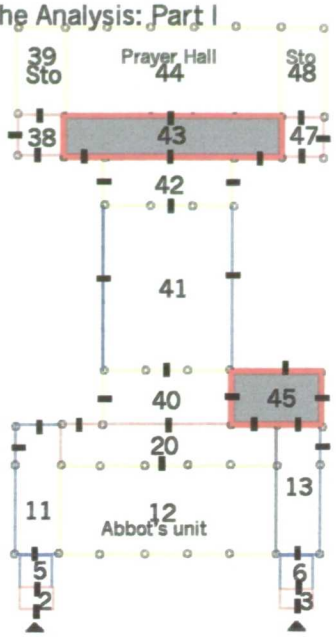


Figure 5.103 Spaces 43 and 45, house 3

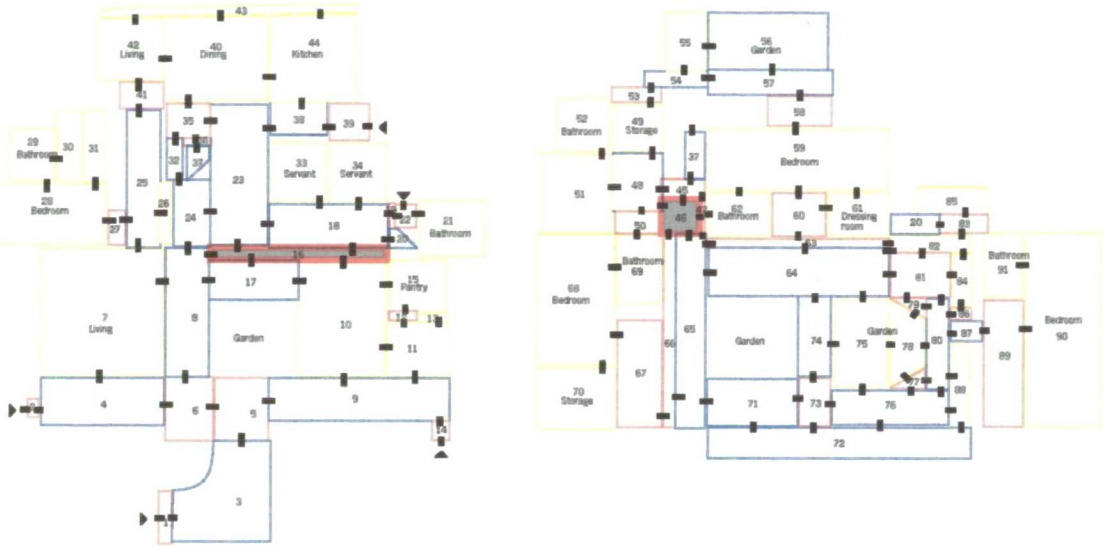


Figure 5.104 Spaces 16 and 46, house 4

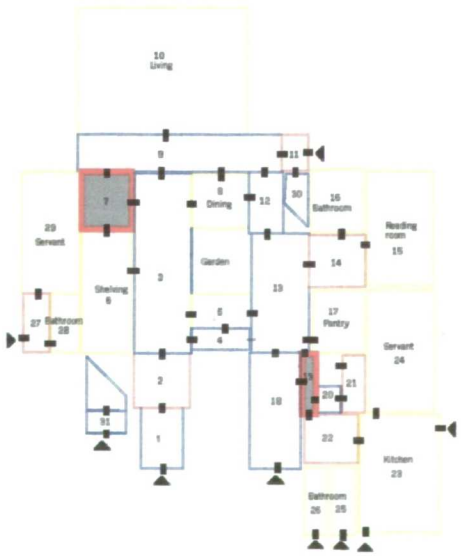


Figure 5.105 Spaces 7 and 19, house 5

Passage Junction Place

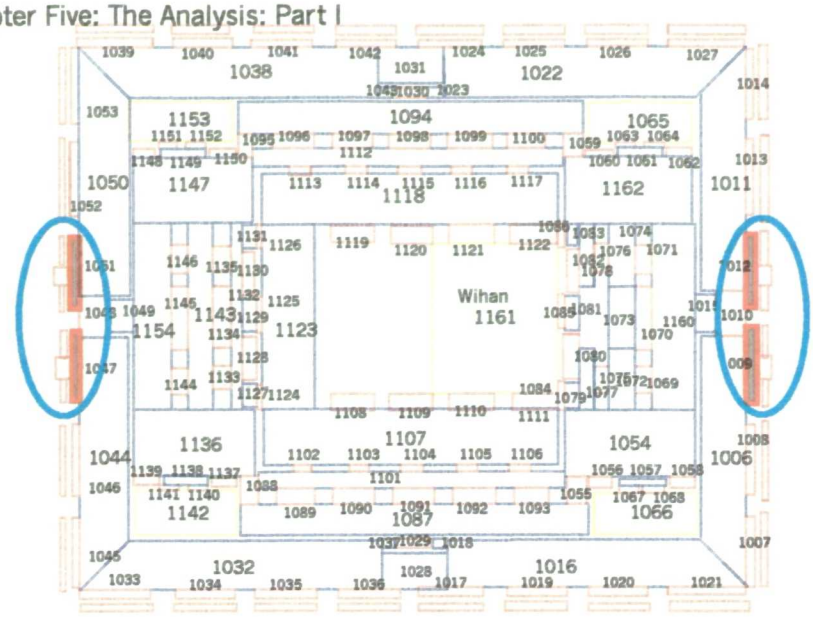


Figure 5.106 Spaces 1009, 1012, 1047 and 1051, temple 2

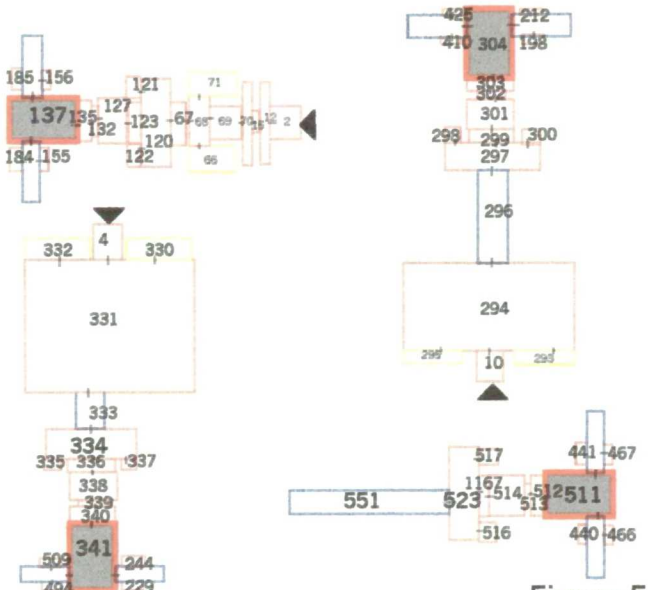


Figure 5.107 Spaces 137, 304, 341 and 511, temple 2

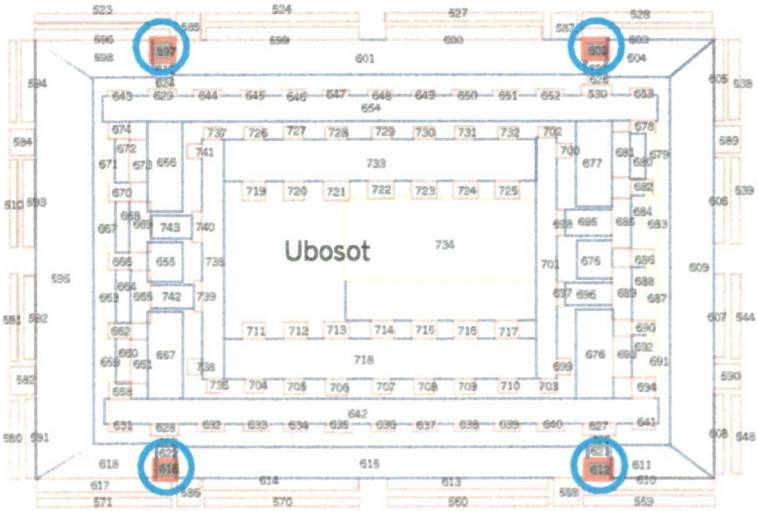


Figure 5.108 Spaces 597, 602, 612 and 616, temple 2

☐ Passage ☐ Junction ☐ Place

In temple 1, spaces 597, 602, 612 and 616 appear to be unremarkable but they play the same important roles as those in temple 2 (Figure 5.108). The relation is subtler in the smaller size temples. Space 41 in temple 4, spaces 9, 104 and 105 in temple 5 and spaces 34 and 36 in temple 6 are all very crucial connections to the sacred areas of the temples (Figures 5.109-5.111). These spaces connect the main movement to the gateway of the temple 4's *ubosot*, the main terrace and the *chedi* complex of temple 5 and the prayer space in temple 6. Even though it is usually small in size and number of spaces, d-junction relation often has the highest integration value of all 12 relations (1.044 in houses and 0.776 in temples). In short, d-junction relations work as the integrator of the integrator, d-passage relation. It is very important in complex structures like temples and can work in both ways for the crucial integration or segregation between two very important parts.

12) d-place type space

The concept of this relation is not very widespread in houses where privacy is the main concern. There are 24 d-place type spaces in four out of six Thai houses (7%). The biggest proportion of this space is in house 4 (14%). 17 out of 24 d-place type spaces are outdoor spaces on terraces in contrast to a-place relation where the majority of its space is indoor. In many cases, d-place relation is in terrace spaces that are used for the room-like functions. These spaces are important points that help to define the meaning of the terrace's vast open space. Space 27 in house 3 is partially enclosed space of a pavilion-like dining hall while spaces 5 and 8 in house 5 are open spaces that are turned into the dining and living areas by everyday activities (Figures 5.112-5.113). In fact, it is only in house 4 where the relation is really in enclosed spaces; they are spaces 7, 40, 42, 43, 44 and 59 (Figure 5.114).

In Thai temples, the proportion of d-place type spaces (6.3%) is even smaller than in houses (7.1%). However, the relation consistently exists in every temple and highest in temple 2 (9%). d-place type spaces in Thai temples often have highly religious importance and are located on two main axes in plans. The prayer hall of the *ubosot* is always d-place type space and always on east-west axis. In temple 1, there are a series of d-place type spaces that lie on the east-west (e.g. spaces 18, 20, 30 and 33) and north-south axes (e.g. spaces 238, 239, 252 and 253). They are all indoor spaces used as gathering places by worshippers (Figure 5.115). Apart from the spaces inside the *ubosot*, d-place type spaces are often outdoor spaces and are common in every selected Thai

temple. Most of these spaces are on the terraces such as spaces 546 and 556 in temple 1, spaces 680, 686 and 762 in temple 2, spaces 78 in temples 3 and 4 and spaces 127 and 133 in temple 5 (Figures 5.116-5.120). Some are in the courtyard network such as spaces 118, 861 and 968 in temple 2 (Figure 5.121).

The fact that d-place type space can be both places of activities and open spaces at the same time defines a theoretical concept of the relation as to being the most design-oriented relation of all. The relation is in many open spaces occupied by design objects that enhance the sense of place such as the built-in bench (space 659 and the likes) on temple 1's terrace. d-place are often connected to d-passage type spaces and are usually on the important routes in the buildings. Further discussion in route analysis will look in detail about the relations on important routes. d-place relation has a much higher mean integration value in houses (1.02) than in temples (0.6). In conclusion, the relation is obviously important in structural and experiential terms in both Thai houses and temples. It suggests complexity in spatial sequencing and designate uses, especially when it is formed in partially enclosed space or in open space such as the *chan* space in Thai houses or terrace spaces in Thai temples.

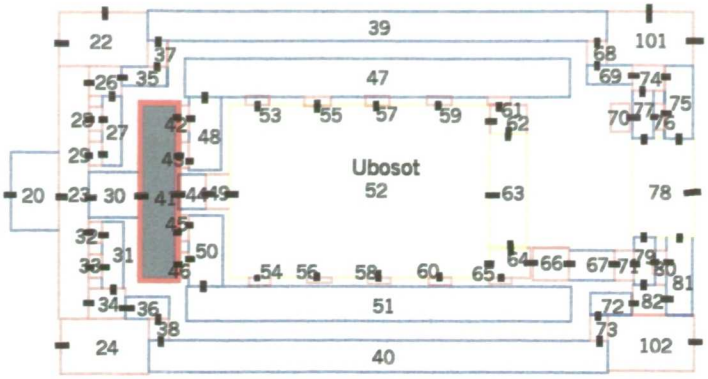


Figure 5.109 Space 41, temple 4

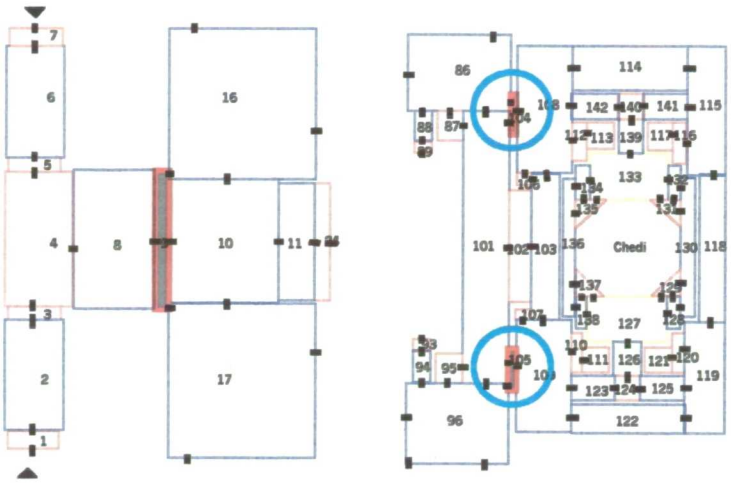
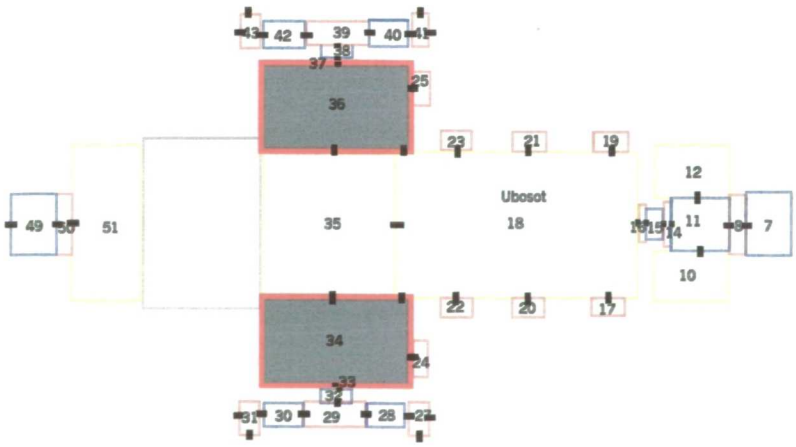


Figure 5.110 Spaces 9, 104 and 105, temple 5



Passage Junction Place

Figure 5.111 Spaces 34 and 36, temple 6

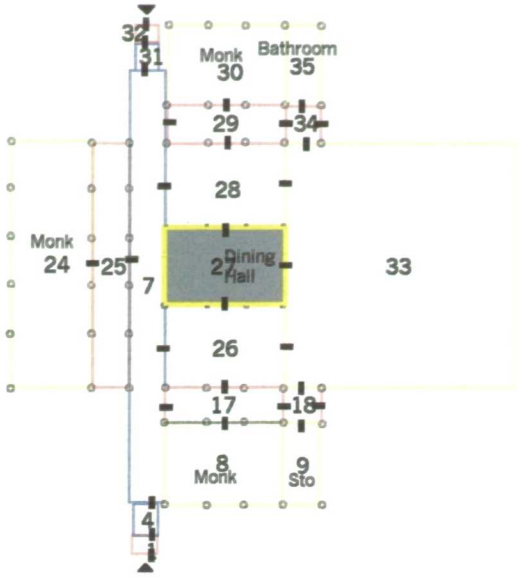


Figure 5.112 Space 27, house 3

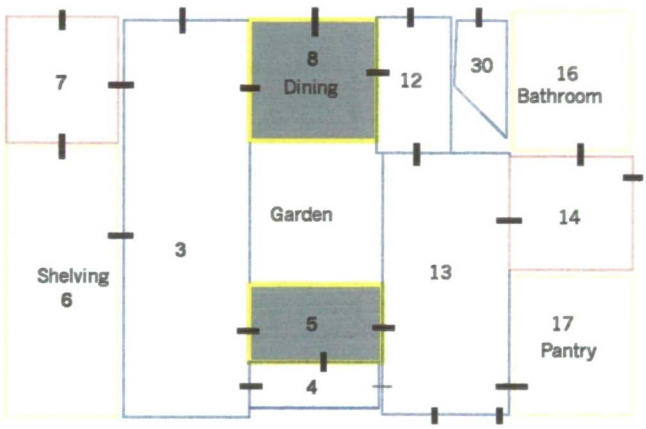
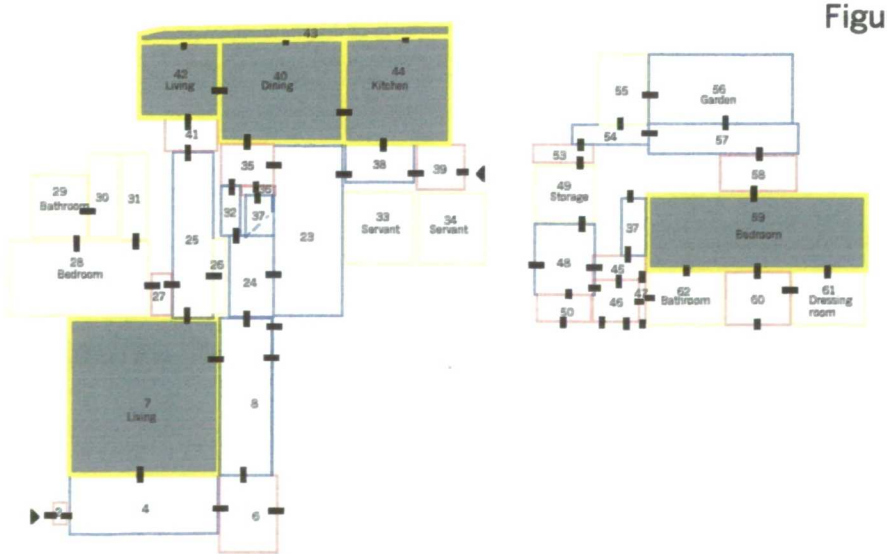


Figure 5.113 Spaces 5 and 8, house 5



Passage Junction Place

Figure 5.114 Spaces 7, 40, 42, 43, 44 and 59, house 4

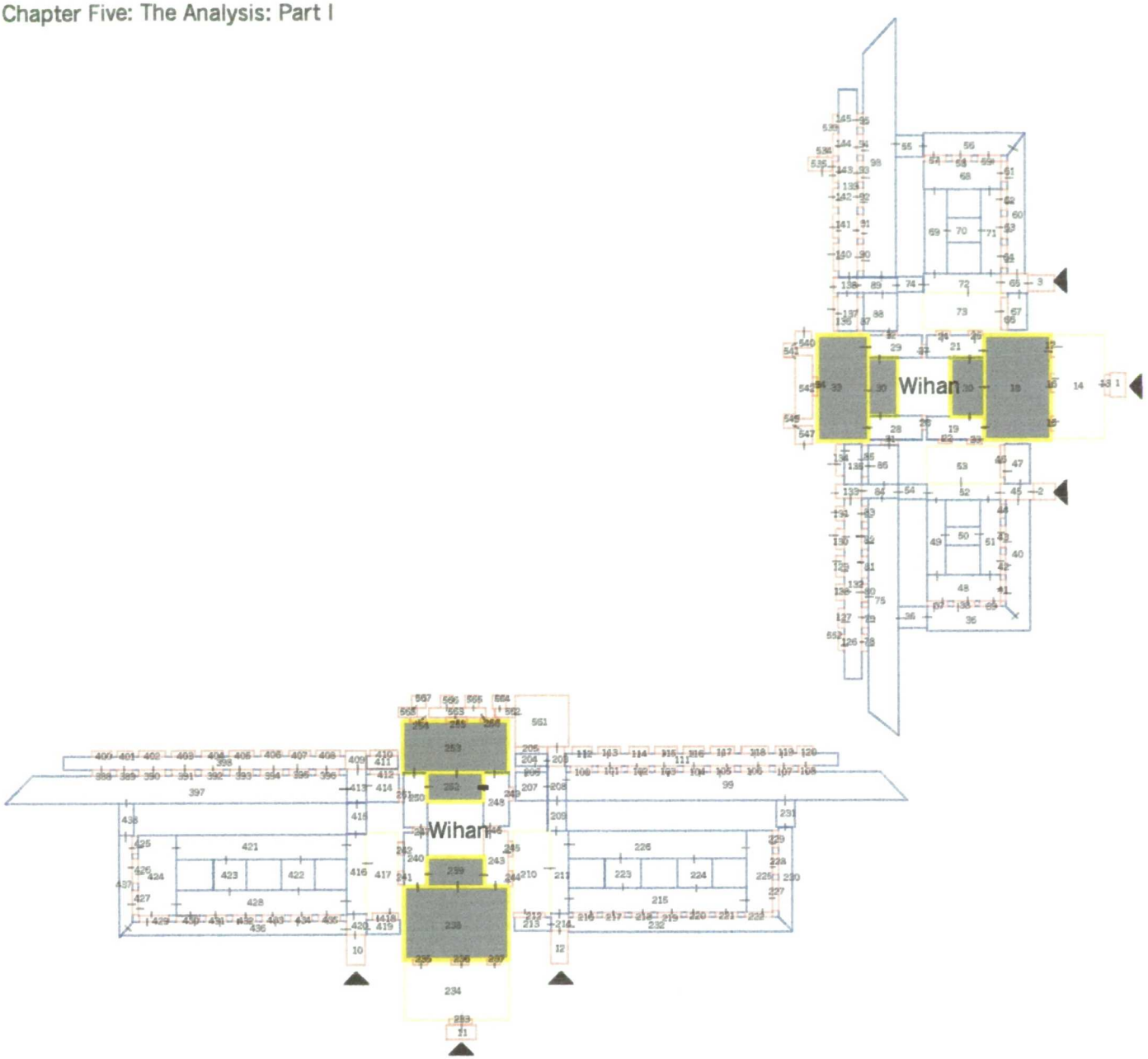


Figure 5.115 Spaces 18, 20, 30, 33, 238, 239, 252 and 253, temple 1

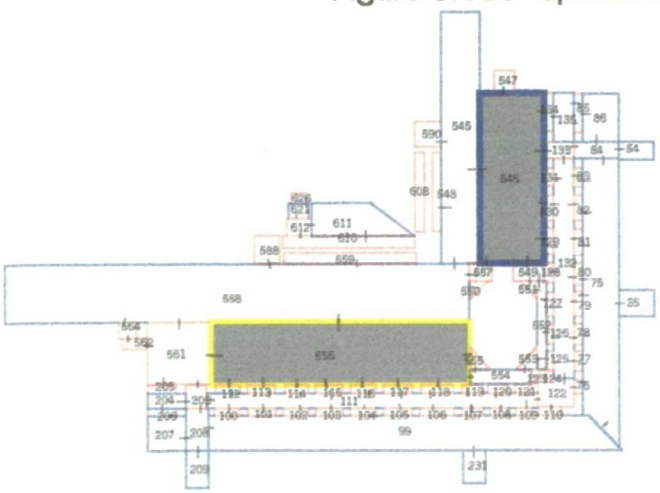


Figure 5.116 Spaces 546 and 556, temple 1

Passage Junction Place

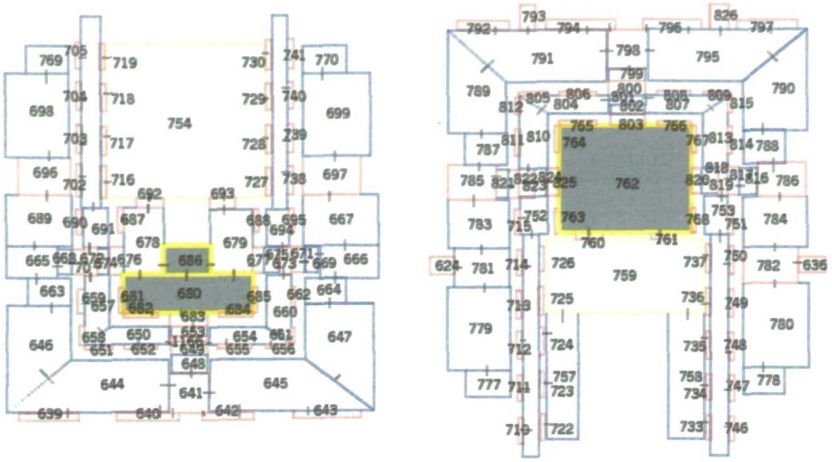


Figure 5.117 Spaces 680, 686 and 762, temple 2

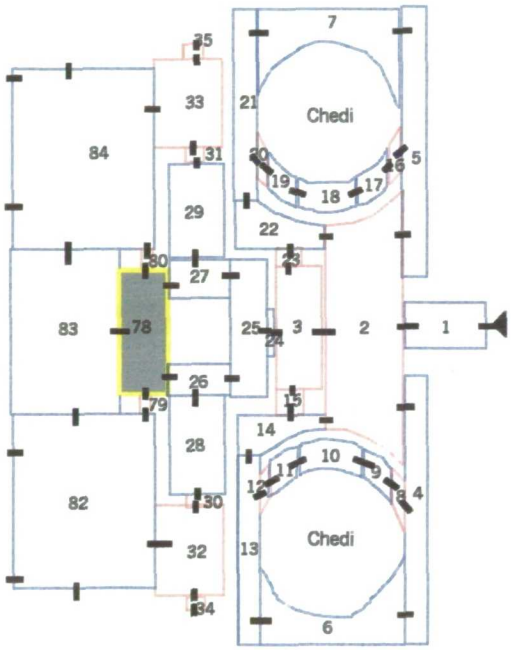
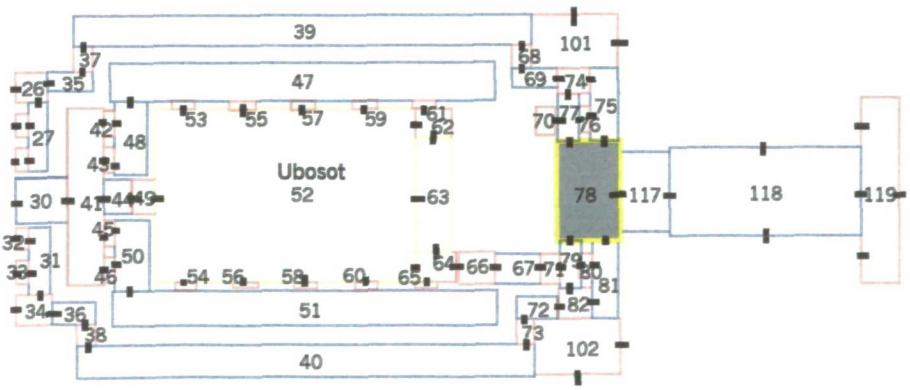


Figure 5.118 Space 78, temple 3



Passage Junction Place

Figure 5.119 Space 78, temple 4

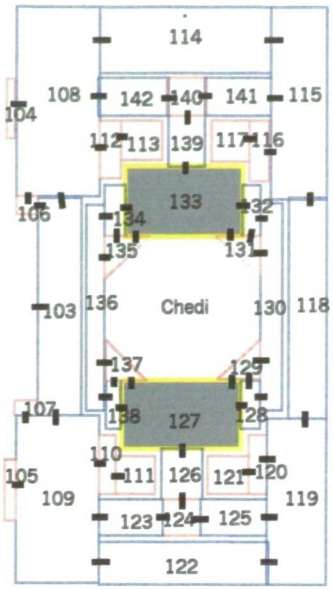
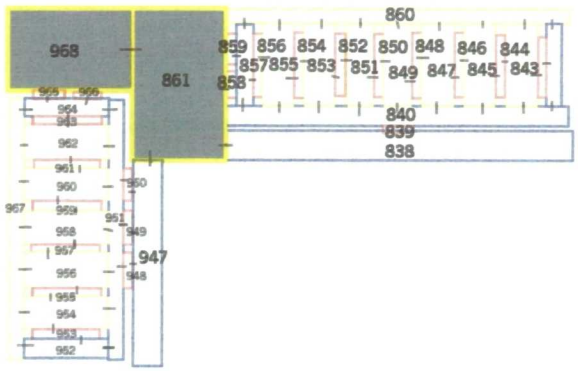
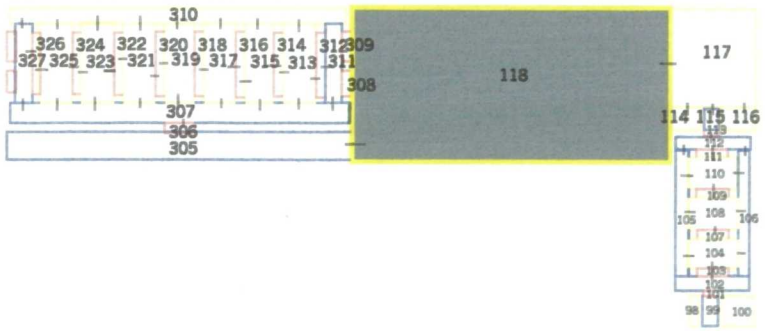


Figure 5.120 Spaces 127 and 133, temple 5





Passage Junction Place

Figure 5.121 Spaces 118, 861 and 968, temple 2

In conclusion, from spaces in the selected Thai houses and temples each relation has unique qualities. **a-passage** type space are very few, only in temples, and oriented toward symbolic qualities. **a-junction** type space is also only in temples and offers virtual connections of different zones of space. **a-place** type space is very strong especially in houses and is related to the idea of privacy more than sacredness. **b-passage** type space is probably the most segregated and is rarely used in Thai architecture. **b-junction** type space is used consistently in houses and forms exclusive sub-complexes. **b-place** type space is the least common and mostly created by design for specific characters. **c-passage** type space effectively connects many parts of open space. **c-junction** type space works as a clear transition between major parts of houses and temples. **c-place** type space plays an integrating role in designated experiences. **d-passage** type space is very expansive and constructive. **d-junction** type space works closely, in local scale, with d-passage type space as the integrator. Finally, **d-place** type space is very design-oriented and very important for religious activities in temples.

At this stage, a-place, c-junction and d-passage type relations seem to be the important ones in terms of number and consistency in spaces of the Thai examples. At present, there is no study that points out these abstract relations in other design cultures. There is evidence that suggests differences among architecture in different societies or even in different periods. For example, c-type space dominates in some mediaeval and early English houses while a-type space dominates in some 17-18th century English houses (Hanson, 1999). However, in order to fully compare across many cultures more research is needed. With this theoretical analysis, the general concept of these abstract relations is seen as design elements. The illustrations show this abstract information in action but do not seek to explain reality which has more dimensions involved. With this understanding, the research moves into the next analysis in search of various 'effects' that are conceived with these elements in space of the selected buildings. The next analysis will investigate further effects of every relation emphasising those of importance for architectural space in general as well as in Thai houses and temples.

At this point of the analysis, we have answered questions of architectural space as to what it 'is' through the logic of what it 'does'. We have seen that each relation when conveyed through certain spaces has different impacts in the system it is in. In the next chapter we proceed toward architectural reality looking at spaces (relations) in their

specific settings. This means space is seen in a fixed position and, more importantly, in relation to every other space in the system. First, through syntactic values of a space which allows precise comparisons of each space in relation to the whole. The analysis will go further into other dimensions of architectural space, functions and architectural element, and in specific parts of designs. In this way, all relations will be exclusively examined and compared in their practical contexts and are thus ready to progress toward the state of architecture.

6. **The Analysis**: Part II: ...to architectural reality

Architectural reality is made of concepts which are designed to serve and express certain intentions to all that are involved with it in any way. The reality in uses and in objects conveys these intentions as one is 'being' in such space. However, it seems that the effects they make are not so clear and easy to measure. How can effects of a space and spatial configuration be read and measured? Which effects need to be specially considered and for what purposes? These are the two main questions being asked in the following analyses: syntactic, design and route analyses. The analysis part II begins by employing the precision of a technique to identify the link between the abstraction and the reality of architectural space. The link, however, is also abstract, describing architectural space through numerical values of integration, control and connectivity, etc (Hillier, Hanson and Graham, 1987). Even though they are abstract in comparison to reality, these values are very descriptive and precise in their environment.

The task is then to use the precision of these values as the linkage to the deeper understanding of the other dimensions of architectural space. Design analysis looks at the last two stages of space on the process to be realised into architecture: the functional and architectural-element dimensions. These two dimensions are conceived in architecture in a completely interdependent way; that is, the notion of utility in a space is described as a 'function' which is contained or defined by a building's part described as an 'architectural element'. The analysis of these two dimensions employs the syntactic values and on-site observation to pinpoint the effects that a space has on our conception in built environment. Therefore, the syntactic and design analyses are the ways to measure and read the effect in architectural space, respectively.

Further question to be asked seems to be 'which' effects are more vital to the architecture in terms of use and design. Route analysis looks at specific routes that express the general concept of the building. Architectural space is seen as both a pure physical 'object' (e.g. the route from the front towards the back through the centre) and as 'social' activities in space (e.g. the usual routes to go to pray or to avoid it). As a result, special characters are more visible as a piece of architecture is now known by what it 'does' from the 'way' it is configured. Therefore, the on-site participation relates what a spatial configuration 'is' to what it 'does'. The syntactic analysis shows how the structure-

experience relations can be practically comprehended and precisely compared in their specific settings of the selected examples. Consequently, a complete understanding of the structural and experiential dimensions on a global scale is attained.

6.1 Syntactic analysis

Numerical data: Tables 6.1-6.2 (p.300)
Graphical data: Figures 6.1-6.13

When a specific system of relations is formed, it creates sets of effects in space in the varied forms of individual buildings. This phenomenon is often beyond intuition and thus many effects in space are routinely taken for granted by architects and users. This analysis is therefore, aimed at following the 'effects' of these relations in different spatial configurations. In other words, the analysis looks at the end 'product' of specific relations at work in individual architectural spaces. Space Syntax techniques are employed to calculate syntactic values of every space in 2709 convex spaces of the selected examples and of each selected buildings as a whole (Tables 6.1 and 6.2). The calculation of syntactic values follows the techniques used in Hillier, Hanson and Graham (1987) (details in Appendix).

All the syntactic values are useful in order to identify the logic that links structure of space to experience and to function and architectural element. However, not all of them work at the same scale; that is, the structure is the most global while architectural element is the most local. The analysis therefore approaches space from both a global and a local scale. At the global scale analysis, integration value, Base Difference Factor (BDF), Space-Link Ratio (SLR) and depth analyses are particularly useful when comparing across the selected examples or groups of spaces. At the local scale analysis, BDF, connectivity, control and integration values seem to be useful when analysing or comparing individual spaces or small sets of spaces. In addition, the consideration of space types helps to differentiate the effects of individual spaces and the total effects created when different types work together as a whole.

The analysis will firstly discuss each building as a whole configuration consisting of individual spaces (detailed information of every space in tables h1-h6 and t1-t6 in appendix). Each space has the integration value in relation to all spaces in the building

according to its location in plan. Through the graphical data, one can establish the understanding of what the building 'is' as a spatial configuration but only in relation to the concept of what it 'does' will validate this information. In this way, the analysis renders a building as the outcome of relations between structure and experience in all spaces of the building. Relations created among a-, b-, c-, d-, passage-, junction- and place-type spaces will now be seen in their specific settings instead of theoretical one as in chapter 5. In doing so, the link between abstraction and architectural reality as well as the effects of space or its 'purposes' can be read and measured in detail.

Secondly, the analysis is made at a global scale; that is, the total information from the selected houses and temples are compared. Therefore, the important structure-experience relations in each group will be more visible through their use in actual designs which is presented in the integration maps (Figures 6.2-6.13). The same colour range differentiates the integration values of space; that is, the integration value of 1.1 range, for example, will have the same colour, light green, across all the examples in order to synchronise and unify the global and local scale reading of the selected spaces. The higher the integration value the more influential the space is in the structural dimension. The highest integration value among all spaces in the study is 1.7 range, red, in house 3 while 0.3 range, dark grey, in temple 2 is the lowest. The experiential dimension and connectivity of each space are also illustrated on a convex space below.

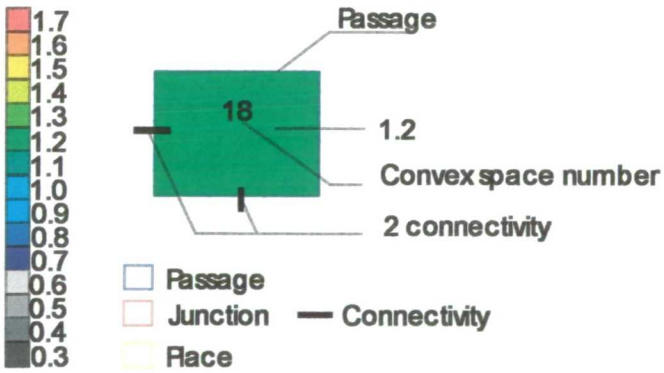


Figure 6.1 Explanation of Integration map

Traditional Thai Houses: **Houses 1 – 6**: Basic syntactic data						
House number	Number of space	**Space-Link Ratio** (no. of links + 1/no. of convex)	Integration with exterior mean	min.	max.	**Base Difference Factor**
1	35	1.222 (44/36)	0.818	0.570	1.275	**0.867**
2	42	1.233 (53/43)	0.944	0.553	1.658	0.766
3	61	1.484 (92/62)	**1.078**	0.570	**1.788**	0.761
4	**91**	**1.489** (137/92)	0.744	**0.419**	1.049	0.842
5	58	1.271 (75/59)	0.875	0.542	1.341	0.865
6	53	1.056 (57/54)	0.703	0.452	1.129	0.835
Mean	**56**	**1.239**	**0.860**	**0.518**	**1.373**	**0.823**
Total space = **340** + 6 exterior spaces						

Table 6.1. Basic syntactical data of Houses 1-6

Traditional Thai temples: **Temples 1 – 6**: Basic syntactic data						
Temple number	Number of space	**Space-Link Ratio** (no. of links + 1/no. of convex)	Integration with exterior mean	Integration with exterior min.	Integration with exterior max.	**Base Difference Factor**
1	743	**1.515** (1127/744)	**0.808**	0.460	**1.206**	0.828
2	**1168**	1.460 (1707/1169)	0.604	**0.370**	0.875	0.859
3	130	1.344 (176/131)	0.710	0.456	0.996	**0.879**
4	131	1.273 (168/132)	0.705	0.448	1.015	0.850
5	142	1.329 (190/143)	0.691	0.422	1.005	0.847
6	55	1.286 (72/56)	0.691	0.434	0.815	0.869
Mean	**394**	**1.368**	**0.702**	**0.432**	**0.985**	**0.855**
Total space = **2369** + 6 exterior spaces						

Table 6.2. Basic syntactical data of Temples 1-6

Syntactic analysis of the selected Thai houses

The conventional Thai houses:

Space in house 1 is dominated by c-type based relations reflecting in the largest proportion of c-junction in all houses (26%). c-passage relation plays an important structural role such as space 9 which connects front and back parts of the house with the third highest integration value of all spaces (1.242). However, in practice this space has a double-role effect on movement; that is, it is also the segregator that completely separates front and back parts of the house. Another important relation is d-passage with the highest mean integration value (0.996) including space 20 which has the highest integration (1.275) and control values in the house (2.75). The most stable relation is a-place (all a-type are place-type spaces) with the lowest mean integration value (0.649).

The house as a whole is the least integrated among the three conventional examples. However, it has the highest BDF value of all houses (0.867) which suggests that its system is the most homogeneous in integration values of its spaces. House 1' spaces have a narrow range of integration values, from 1.2 to 0.5 compared to 1.7 to 0.5 in the least homogeneous house 3. As a result, the integration map of house 1 shows a highly harmonious range of colour throughout the house (Figure 6.2). In short, the effects of space can be read and measured in detail through the consideration of local properties which reflect the global characteristics of the house. As in house 1, the space is read firstly as being sectional since c-junction is dominant. Secondly, as its spatial configuration is very homogeneous, the house is also a well-connected design with a moderate proportion of the segregating b-type based relation (10%). Finally, since the spatial configuration is quite simple, house 1 has low Space-Link Ratio (1.222) which seems to be influenced by its highly-integrated d-passage spaces.

House 2 is highly integrated (0.944) as well as having a wide range of integration values in its spaces and thus has a low BDF value at 0.766 (Figure 6.3); i.e. it is more differentiated than house 1. The house creates 9 out of 12 structure-experience relations (section 5.3); a-place has the largest number of spaces (9). Similar to house 1, every a-type is place-type space in house 2; the relation has the lowest mean integration value suggesting the effect of seclusion for privacy. Another strong effect is b-junction type relation with a high integration value (0.929) from its experience of being junction since b-type space usually creates segregation. This fact corresponds to the real experience of junction being very

strong in house 2. In fact, all conventional examples tend to have strong experience of junction, as we shall see also in house 3. The highest integration value is in a c-passage space, space 18 (1.658). However, d-passage is the strongest integrator as a whole (1.294).

House 2 has an interesting relationship between its SLR, mean integration value and BDF. The wide range of integration value suggests that its spaces are quite different from one another. In fact, many parts of the house seem to be quite independent from one another in real experience. The low ratio of links to spaces (SLR) showing that the structure as a whole is not very complicated and economical enough to maintain the high integration value. This suggests that of all possible relations a-place is greatest in number followed by b-junction; both of them tend to form independent sub-complexes and to produce a tree-like structure. However, b-junction is well integrated to the whole structure because of the high proportion of the integrated c-passage (17%), c-junction (17%) and d-passage relations (12%). We can deduce from house 2 that the b-junction relation used in Thai houses produces the dual effect of providing independence whilst still being well integrated into the main system. This creates a system that has low SLR but a relatively high integration value.

House 3 has the highest integration value of all the selected houses (1.078). It also has the second highest SLR (1.489) and the lowest BDF (0.761). These values suggests complicated and extensive character of the structure. Of all 340 spaces in the selected houses the greatest integration value (1.788) is in d-place space at space 33 (Figure 6.4). It is the space in front of the dining hall where all the monks in the compound gather. House 3 has the largest proportion of d-junction space in the selected houses (18%) but it is d-place relation that has the highest mean integration value in this house (1.514). Within this context, it seems that place-type is a highly integrated type especially when it is combined with d-type space. It is expected that this effect will be clearer and stronger in temple space where the d-place relation is related to sacredness.

Although the main character of the house is based on d-type, it also contains a high proportion of relations involving c- and a-type spaces. There are 16 c-type and 22 junction-type spaces here producing 9 c-junction spaces at a moderate mean integration value (0.9). In house 3, b-junction seems to have the usual role found in the Thai house, as it directly connects with a-place, the most stable relation and largest proportion of the

house's space (30%). d-place relation is in the open space of house 3 which is used slightly different from a family home as it is designed to receive the formal gathering of monks (e.g. spaces 33, 46 and 51). They have powerful integrated effects because of their locations and use. These d-place spaces influence the high integration value and SLR of house 3's structure. These powerful spaces on *chan* space are fewer in the contemporary Thai houses.

The contemporary Thai houses:
House 4 has the largest number of spaces (91) and a complex structure with the highest SLR (1.489). The house's structure has a low mean integration value (0.744) although with small difference in integration value among its spaces (BDF = 0.842). Consequently, house 4 has the largest proportion of the 'carrier' d-passage space in all the houses (21%). House 4 has 10 different types of relation (the highest number among all the houses) which are dominated by a-place, c-junction and d-passage relations. The number of d-passage and d-junction spaces are very close at 19 and 14 spaces respectively. Unlike the first three houses, d-junction relation has the highest mean integration value (0.844) in this house. However, individually, d-passage space at space 18 has the highest integration value (1.049) reflecting the complex character of the house with many extensive parts and thus high connectivity. As a result, the structure contains the highest proportion of d-place spaces (14%) in all the houses. This effect makes the house full of many small places that are used in specific ways.

With its strong linear character in house 3, many fewer c-passage have higher mean integration value than c-junction spaces. The house also has a high number of c-place spaces (7) holding specific functions (e.g. spaces 49 and 69) that integrate different parts. In house 4, c-place relation has the mixed notion of being both an integrator and generator of isolated sub-complexes as it has moderate mean integration value and connectivity. In this way, c-place resembles d-place relation in the sense that they are both the focus points of the design of the building; c-place is more common in houses because of the privacy-oriented character while d-place is more stressed and common in temples because of the (public) sacredness-oriented character. In conclusion, the high number of b-place (the second highest in the selected houses), c-place and d-passage relations make house 4's structure complex and deep (Figure 6.5).

House 5 has very few spaces (58) considering that it is a two-storey house. It also has 10 relations but the house is much more integrated and shallower than house 4; that is the mean integration value of 0.875 and SLR at 1.271 compared to 0.744 and 1.489 in house 4. House 5 has the second highest BDF (0.865) even though it has the second highest proportion of the isolated a-place space (31%) with quite a high mean integration value (0.705). Compared to house 4, house 5 has an even distribution of structural properties in its spaces without putting too many into c-and d-type spaces which could make architecture complex as in house 4. House 5's design mainly focuses on place-based relations. It maintains simplicity by having the smallest proportion of the junction-based relations at 22% (30-40% in houses 1 to 4 and 23% in house 6). Globally, the house is very well structured and has homogeneous integration values with an emphasis on privacy-based relations of a- and b-place relations (Figure 6.6).

House 6 contains the largest proportion of a-place space (51%) and only 6 out of 12 structure-experience relations are formed. The house has the highest number of b-passage and b-junction spaces (19%). They both deal with a-place spaces thereby creating many isolated b-type sub-complexes with a low mean integration (0.626). Despite fewer occurrences b-passage generally has a stronger segregation effect on the whole system than b-junction relation does. House 6 has the smallest area among the selected houses which is why there are so few indirect connections found in b-place, c-place, d-junction or d-place relations. Houses 6 and 5 are the only two houses that have more passage-based than junction-based spaces creating overall straightforward experience of movement in these two stories houses. d-passage relation has the highest integration value (1.129) but appears in only 2 spaces, spaces 1 and 2, which become the root of the structure from which every relation in the house starts.

Of all the selected houses, the structure of house 6 has the smallest ratio of links to spaces (1.056) and the lowest mean integration value (0.703). The range of integration values starts from the highest d-passage at 1.129 to 0.452 of a-place relation. This reflects in the very high BDF (0.835) which still suggests that integration values are well distributed in the structure (Figure 6.7). House 6 also has the highest number of c-passage spaces in the selected houses; together with c-junction spaces, they generate the effect of loose connections creating isolated sub complexes (privacy) in many parts of the house. From house 6, it shows that the lack of many d-based relations and spaces heavily

influences the low degrees of global integration and complexity of a structure. Unlike any other selected houses, house 6 has more b-type than d-type space and this greatly reduces the complexity of the whole house. However, this does not necessarily mean that the house will be shallow in real experience since there are many b-junction spaces which tend to create exclusive sub-complexes even within a small physical distance causing low mean integration from the exterior space.

The conclusion

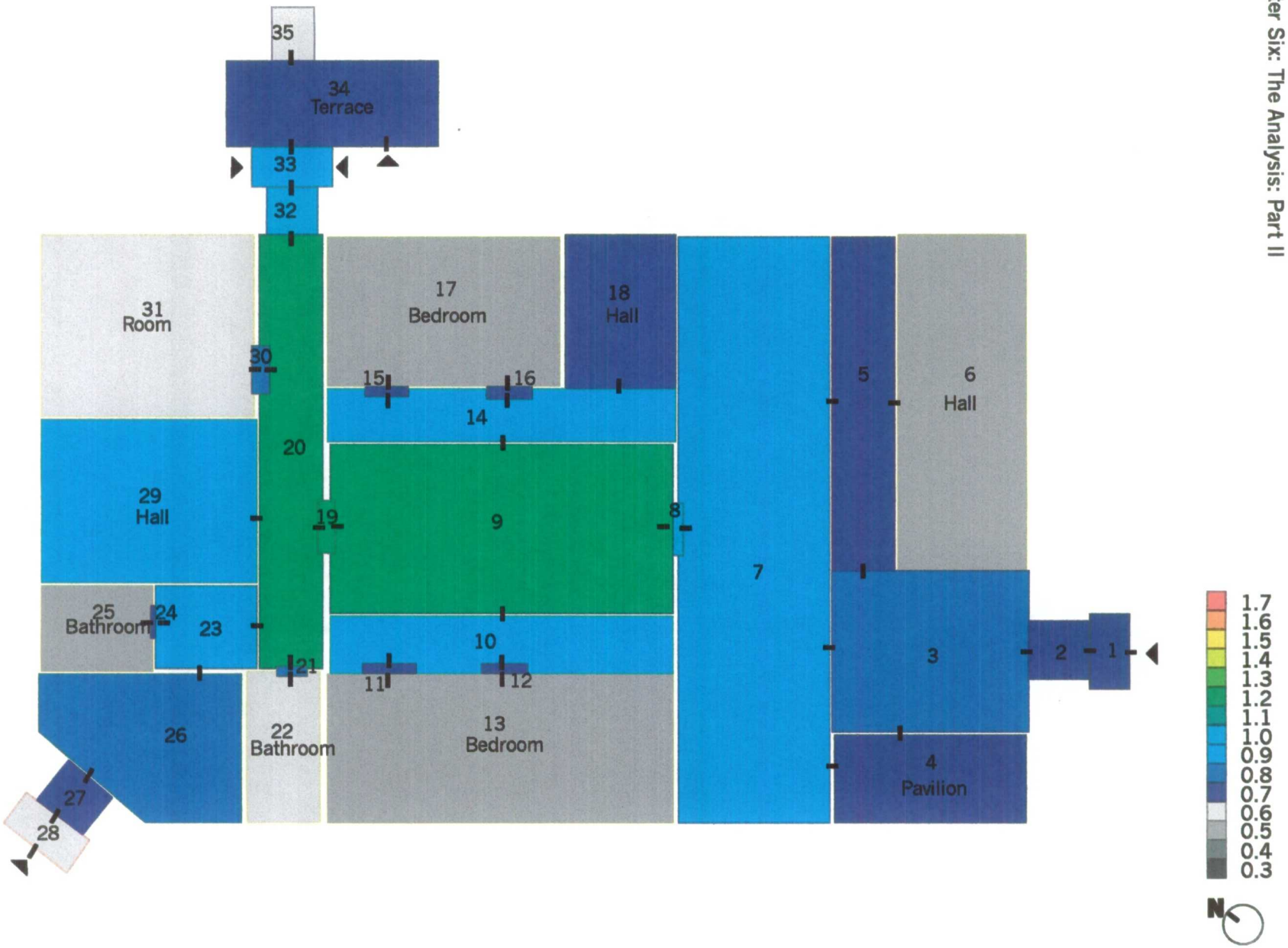
In conclusion, it is clear that the a-place is the most certain relation in the selected Thai houses. The largest proportion of a-place relation is 51% found in house 6, the smallest, 12% in house 4 (the average of 26%). The mean integration value of the relation can be as high as 0.8 in house 3 which is quite a high value considering that it is a-type space. The least certain relation, however, not the lowest in number, is b-place relation which appears in only three houses and has the lowest mean integration value (0.605). a-place, b-junction, c-passage, c-junction and d-passage are the five relations that appear in every house suggesting that they are common and influential in Thai house architecture.

Therefore, it is also clear that some relations are more important and influential than others in terms of both structural properties and experiential qualities. Through the syntactic analysis, it is confirmed that a-place, c-junction and d-passage relations have appeared consistently and have significant values. In the selected Thai houses, a-place relation is the most dominant relation in terms of number (89 spaces), however, with the lowest mean integration value (0.695). c-junction spaces are the second largest (48 spaces) with relatively high mean integration value (0.844). d-passage spaces have the highest mean integration value (1.208) and is the third largest in number (42); the relation is closely associated with the notion of open *chan* space in Thai houses.

a-place is normally in enclosed space suggesting privacy (e.g. space 91, figure 6.5). Privacy in enclose spaces is the reference for other spaces in Thai houses and in others such as English houses (Haraguchi, 1988) where a-place relation is often dominant (Hanson, 1999). c-junction relation characterises the common way to connect indoor and outdoor spaces in Thai houses (e.g. space 15, figure 6.2). d-passage relation is often in the key space on *chan* space (e.g. space 18, figure 6.3). These three relations are also clearly located in the main parts of a graph. a-place usually relates to the deepest, c-junction

usually signifies connections between different zones and d-passage usually involves in the most complex part of a graph. Finally, theoretical analysis confirms the strong concepts of these relations and thus introduces them as elements of design as much as relations in architectural space.

From syntactic analysis, these abstract elements are read and measured by putting them in real contexts of each selected Thai house. These values portray the link between 'effects' of space represented in numerical values and the one presented in built forms. It is now necessary to look at spaces as the concrete formation of spatial relations beyond abstraction of pure space and number. Special interest will be asserted on a-place, c-junction and d-passage relations together with b-junction and c-passage that seems to characterise Thai houses. Before that, the syntactic analysis will be carried on in the selected Thai temples in order to establish the link between abstraction and architectural reality of temple space in the same way that was done in houses.

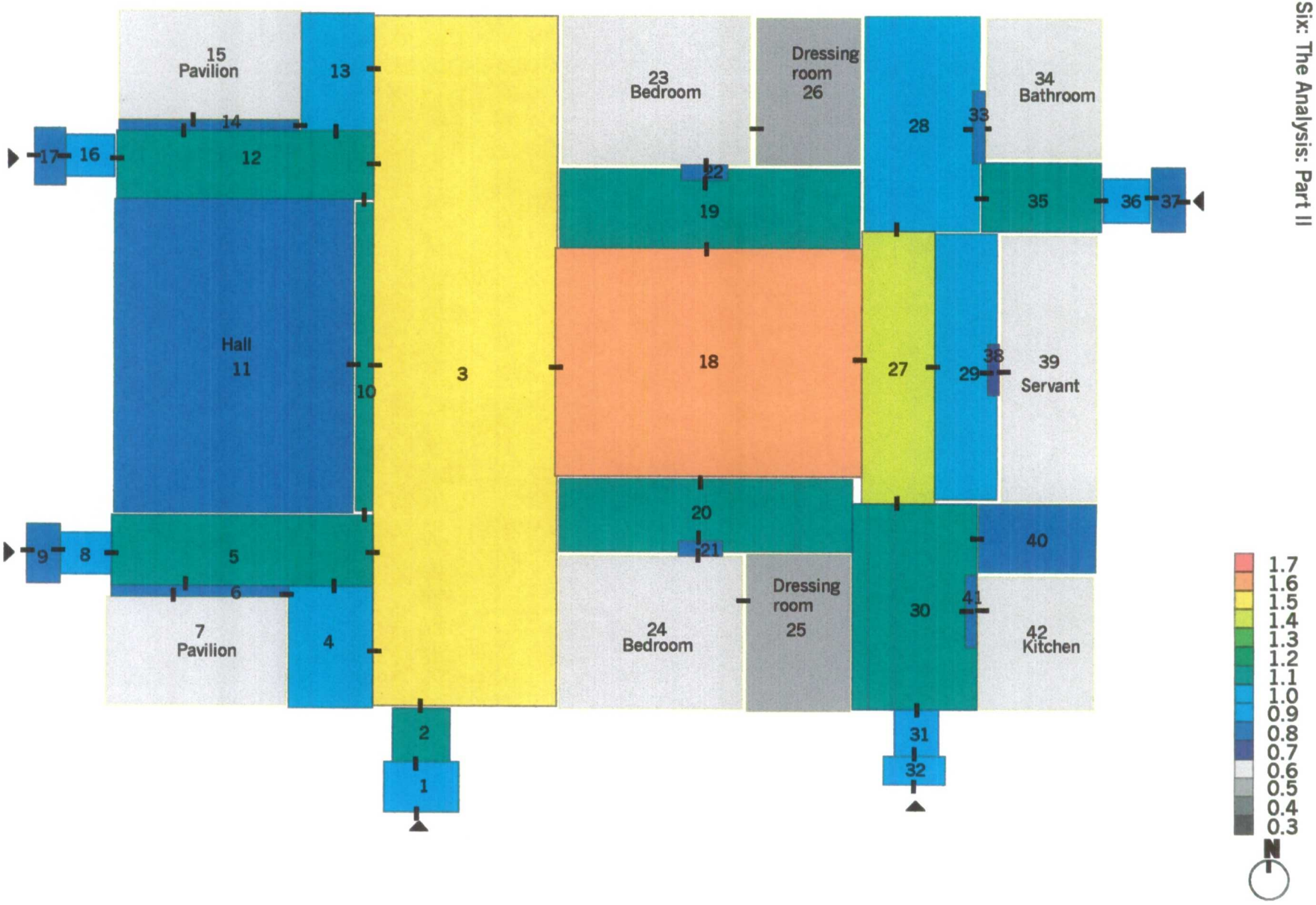


Mean Integration value = 0.818, Base Difference Factor = 0.867

Passage Junction Place

Access to ground

Figure 6.2 House 1 Integration map

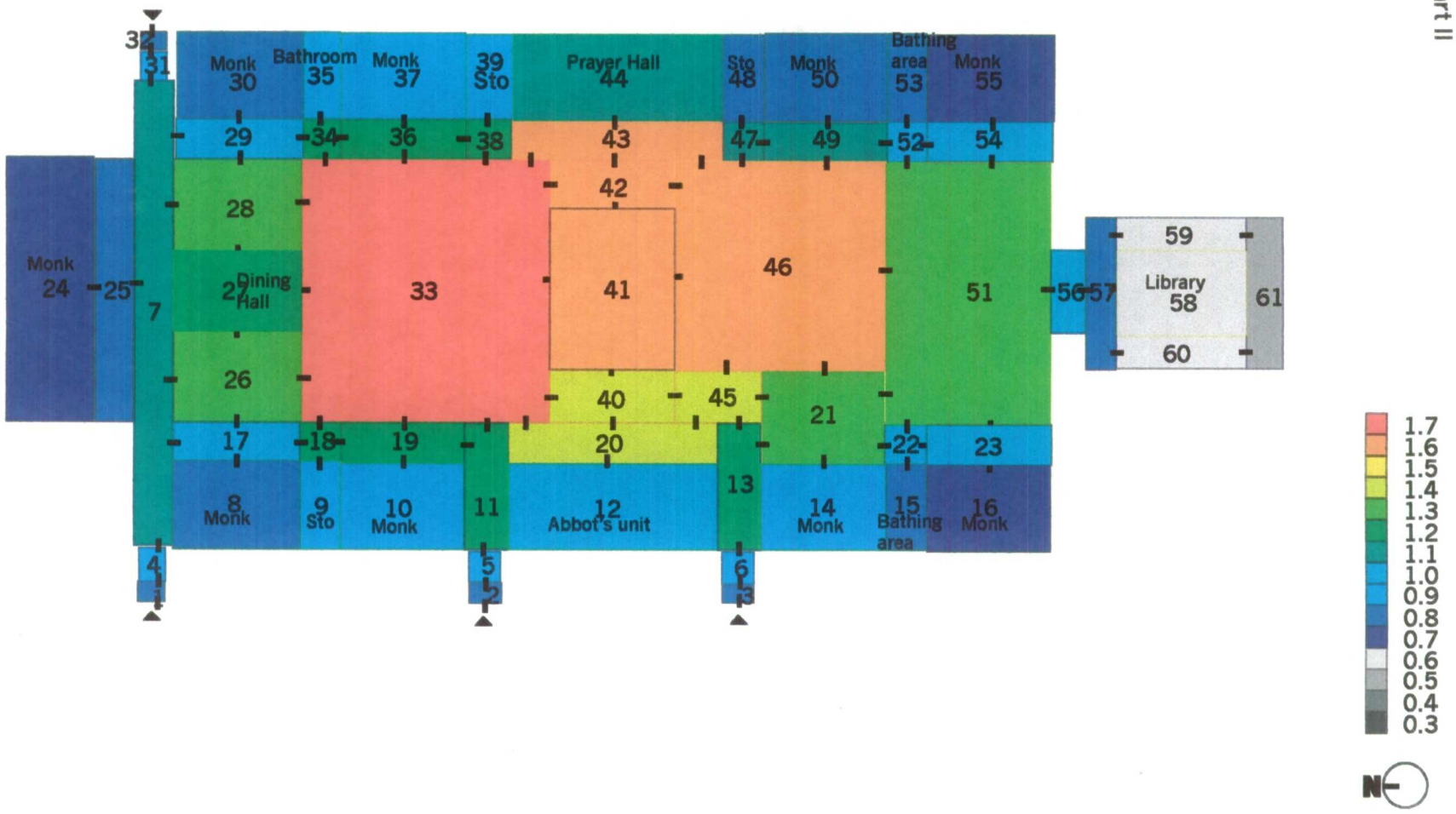


Mean Integration value = 0.944, Base Difference Factor = 0.766

Passage Junction Place

Access to ground

Figure 6.3 House 2 Integration map

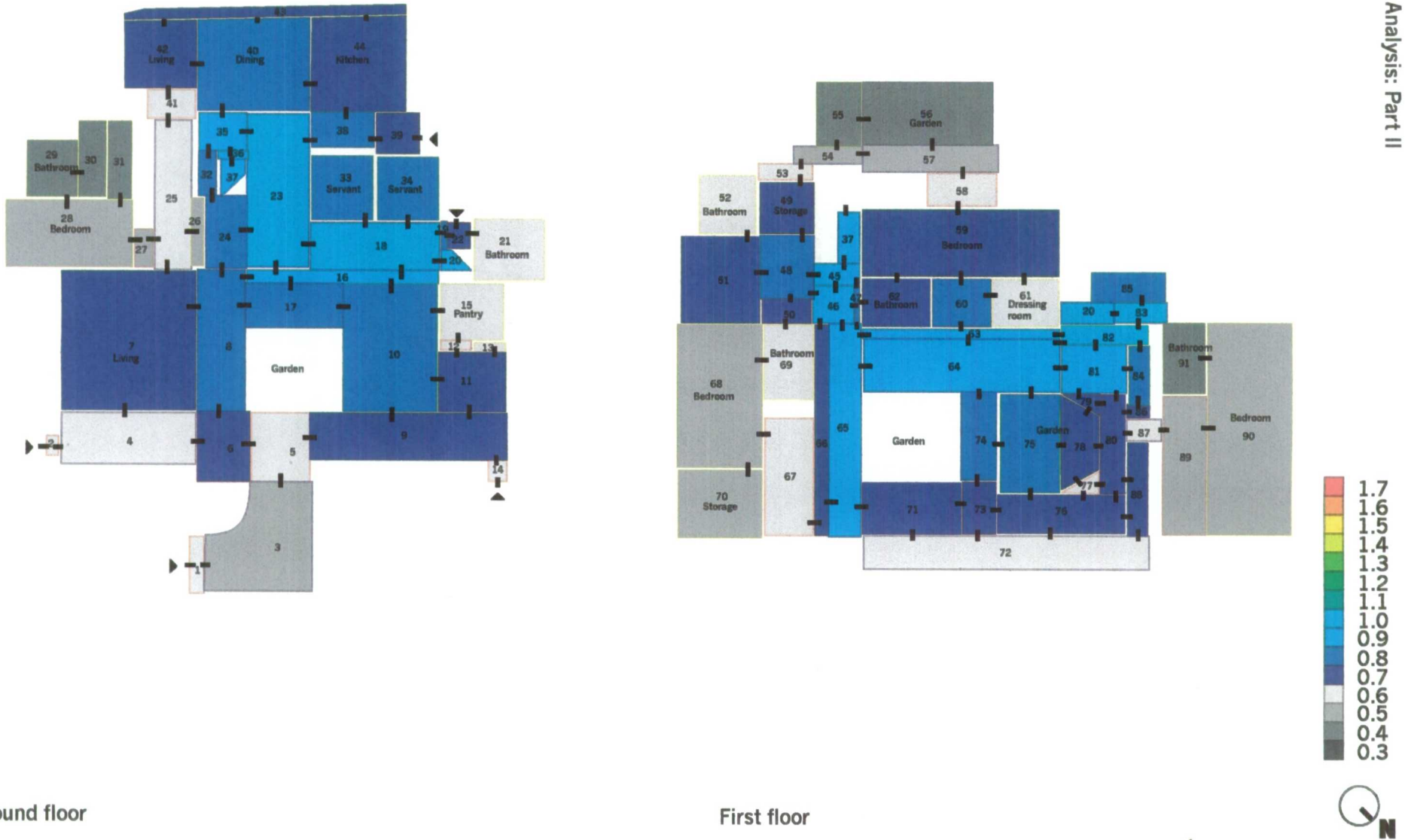


Mean Integration value = 1.078, Base Difference Factor = 0.761

Passage Junction Place

Access to ground

Figure 6.4 House 3 Integration map



Ground floor

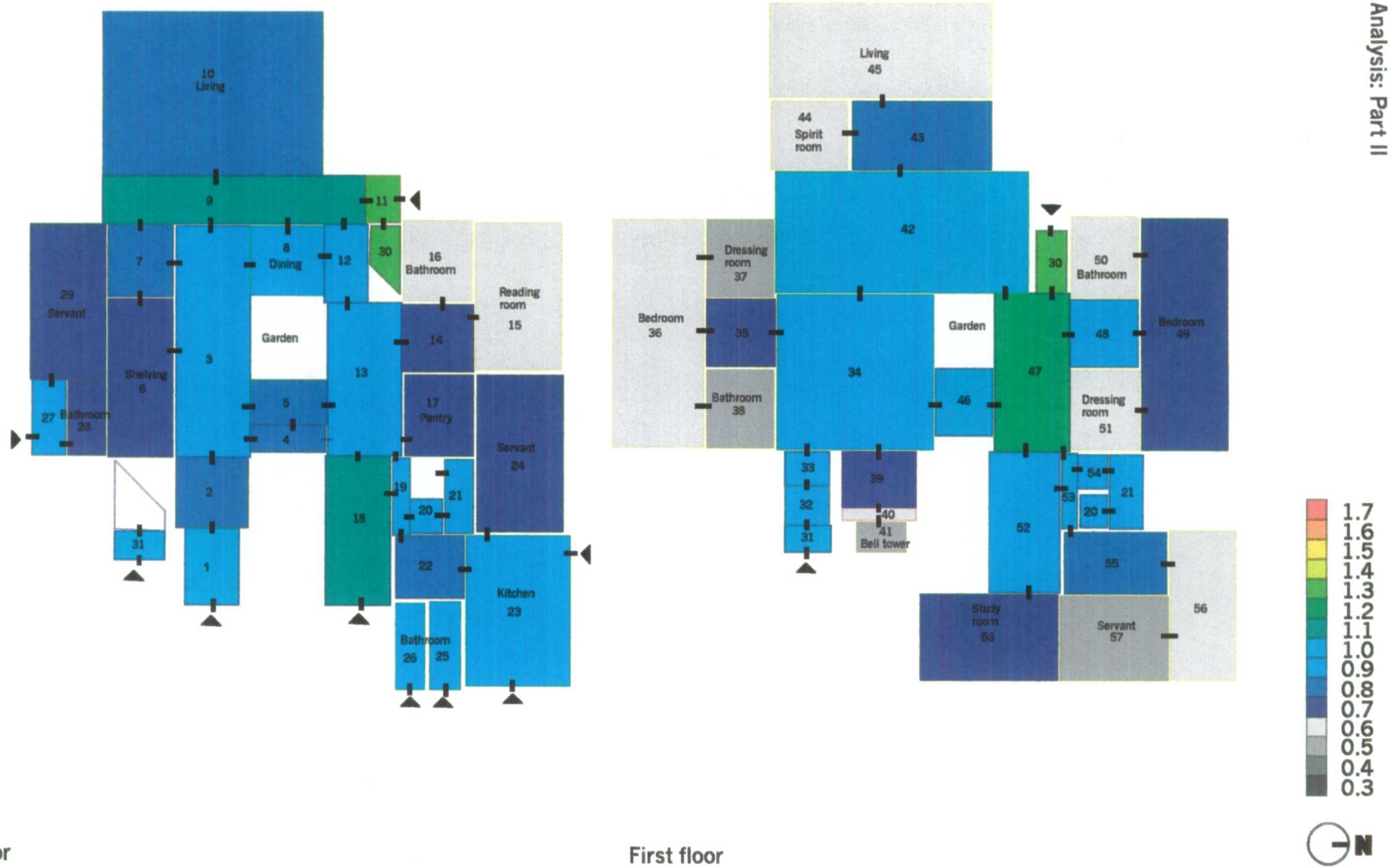
First floor

Mean Integration value = 0.744, Base Difference Factor = 0.842

Passage Junction Place

Access to ground

Figure 6.5 House 4 Integration map



Ground floor

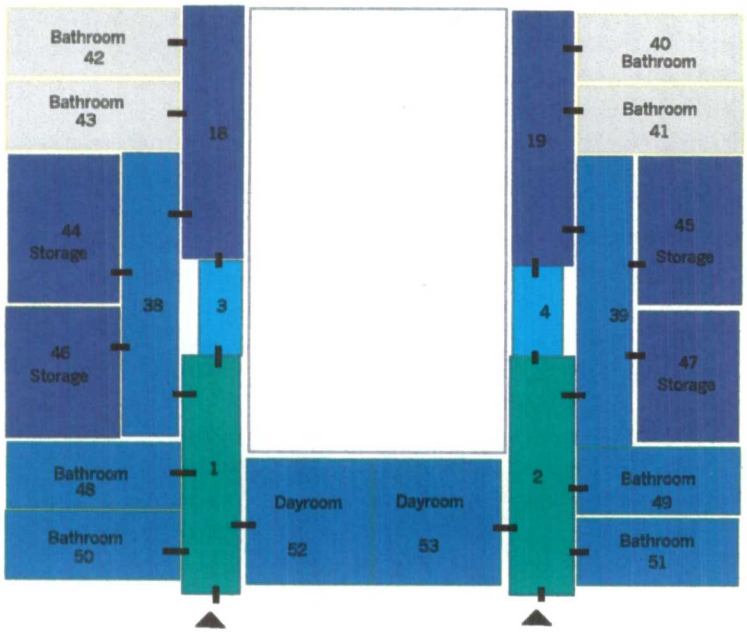
First floor

Mean Integration value = 0.875, Base Difference Factor = 0.865

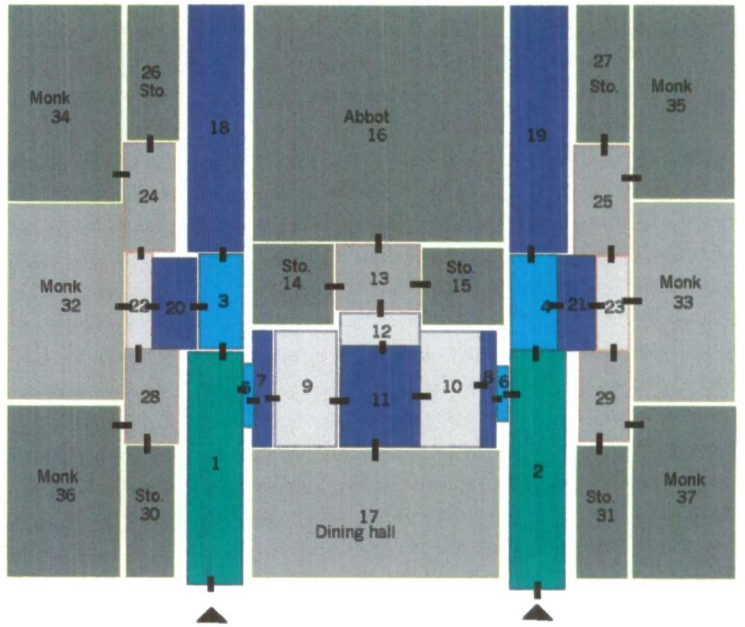
Passage Junction Place

Access to ground

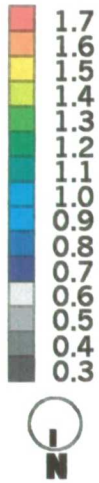
Figure 6.6 House 5 Integration map



Ground floor



First floor



Mean Integration value = 0.703, Base Difference Factor = 0.835

Passage Junction Place

Access to ground

Figure 6.7 House 6 Integration map

Syntactic analysis of the selected Thai temples

The conventional Thai temples:

Temple 1's structure seems to be the most complicated since it has the highest ratio of links to spaces of all selected temples (1.515). The Space-Link Ratio (SLR) starts from a value of 1, a tree-like graph, to the higher values which mean higher degree of complexity of the justified graph. However, the spatial configuration of temple 1 seems to be quite uniform as its Base Difference Factor is 0.8. The closer to a value of 1 the more uniform a configuration which suggests that there is little differentiation among the integration values of the building's spaces. Despite its complexity and very large size, temple 1 is the most integrated among the selected temples (0.808). The highest integration value is space 558, a d-passage space (1.206), while the lowest is 0.460 in most a-junction spaces which often are pocket spaces along the hallway inside the *ubosot* and window spaces.

The integration value of spaces in temple 1 ranges from 1.2 to 0.4 (Figure 6.8). Spaces 558, 545, 537 and 526 on the lower terrace are the only four spaces that have an integration value in the 1.2 range which is the highest range in the selected temples. These spaces are involved in the most complex part of the temple's structure as seen in its justified graph (Figure 5.31). 27% of the temple space have an integration value of about 0.8; most of them are cloister spaces. The ten highest integration values are all in terrace spaces. The other useful syntactic values are control value and connectivity, especially in the highly complex spatial configuration of temples. Normally but not always, a space with high connectivity tends to have high control value. In temple 1, the highest control value (10.25) is in spaces 111, 151, 323 and 398 which also have the highest number of connection (22). They are all d-passage spaces in the cloister.

The relations in temple 1's spaces are to a considerable extent based on its junction spaces (68%). The largest proportion of the temple space is c-junction spaces (45%) with a high mean integration (0.834). Interestingly, a-type is related only to junction-type space, not to place-type as in the selected Thai houses. As a result, a-type in temple 1 does not need any b-type connection in order to exist in the structure since its effect does not express privacy or place-type space as it does in houses. This makes the junction-based relations dominant in both number and effect in temple 1. d-junction has the highest mean integration value of all relations (0.893) while a- and c-junction relations often play the strongest constructive role in local scale.

The temple space as a whole depends on the d-passage relation which does not have the highest mean integration value but it has the strongest integrated effect on the temple's space. The reason for this seems to be that the d-passage relation is in the most noticeable and expansive space in the overall experience of this temple as well as its strategic location between cloister and the *ubosot*. In this way, d-passage spaces offer very high integration values individually through which the temple as a whole acquires a complicated spatial configuration and yet remains very well integrated. In short, the temple architecture is governed by the highly expansive and connecting nature of the d-junction and d-passage relations which are configured around sacredness, the d-place relation in the temple's *ubosot*.

Temple 2 is the only building in the study that contains all twelve theoretical relations in its spaces. The distribution of relations in temple 2 is quite similar to temple 1's; they have about the same proportion of a-junction (15 and 14%, respectively), c- passage (6 and 8%, respectively) and c-junction relations (43 and 45%, respectively). Temple 2 also has the largest proportion of d-place relation of all selected temples (9%). This relation in temples usually represents religious space (e.g. spaces 686 and 1161) and usually has a low to moderate mean integration value (0.589 in temple 2). Due partly to the fact that temple 2 has two centres, the *wihan* and *ubosot*, it has the lowest mean integration value of all selected examples (0.604). This fact also seems to influence a very high ratio of links to spaces (1.46) because more links are needed to cover its loose and complex spatial structure. However, the temple still generates a high BDF (0.859), which is considered very high for its enormous size, suggesting a fine range of integration values among its spaces (Figure 6.9).

The highest integration value in temple 2 is in space 627 (0.875) while space 1081 has the least (0.370). These two spaces are both for circulation purpose but they are used differently as d-passage and a-passage spaces, respectively. Theoretically, a-passage is a very rare relation and its appearance in space is made either by accident, as in this temple, or specifically by design but both cases create symbolic effects in space. It is interesting to note that this relation is usually highly visible (as it is often attached to important spaces) but not well-integrated structurally. In contrast to a-passage, d-passage relation is usually the most constructive space of all relations and often in highly integrated spaces

such as space 627. However, in temple 2 it has the lowest mean integration value of its kind (0.619) in the selected temples. d-junction relation in this temple has the highest mean integration value (0.644) but it is the lowest among the selected temples. Similarities between temples 1 and 2 are in large-scale effects of d-passage and the local effect of d-junction relations. However, temple 2 has a much higher proportion of place-based relations than temple 1.

Because of the largest proportion of place-type space (15%), temple 2 is the only temple that has the mean integration value of b-place relation (0.650) higher than that of the d-passage. Of all the selected temples, temple 2 seems to be the most place-oriented which seems to indicate its function-conscious configuration. Some c-place spaces in this temple contain quite important functions such as the prayer halls of the *ubosot* (spaces 754 and 759). a- and b-place type spaces in this temple are all outdoor spaces and have moderate mean integration values (0.596 and 0.65, respectively). d-place relation is usually in indoor spaces with moderate mean integration value (0.589). d-place relation seems to be highly constructive in the structural dimension and significant in the experiential dimension. In this way, when the relation is kept inside the temple its effect on the whole is reduced numerically but never in practice. This relationship of d-place relation and sacredness of Thai temples, as well as the well-distributed type of relations in temple 2, is the effect achieved by strategy in design.

Temple 3's structure works as two independent systems of inner core and outer 'successive waves' of terrace and cloister spaces. However, the temple has the highest BDF of all selected temples (0.879) suggesting the high consistency of the integration values of the temple's spaces (Figure 6.10). Similar to temple 1, the temple contains just seven types of relation with no b-type based relations. The lack of b-type in temple 3 suggests that the structure is full of connected circuits and thus high connectivity (Space-Link Ratio of 1.344). Consequently, the temple has the largest proportion of c-junction space (42%). Temple 3 has the smallest number and proportion of place-type spaces in the selected temples with the dominant d-place spaces which are used for religious purposes (e.g. spaces 78, 102 and 105) with moderate mean integration value (0.687). Space 96 is the only a-place space; it is an altar-like space that was not designed to be used so in the original design but was later defined by activities.

As a whole, temple 3 is highly integrated (0.710) with d-junction as the highest integrated relation in the temple. Similar to temples 1 and 2, the highest integration value space in this temple is a d-passage space, space 83 (0.996) which distributes movement from the main entrance to different parts of the temple. However, the most connected space is the prayer hall (7), a d-place space (space 105) which has a very low integration value (0.546). This is unusual for d-type space but strategically used in this way to achieve the effect of 'sacredness'. This effect is much emphasised in temple 3 by physically blocking the visibility from the outside, since there are no window spaces in the *ubosot,* and shielding the d-place space in the *ubosot* with other relations. In conventional Thai temples, multiple layers of spaces with high control value and series of low integrated spaces are often used to emphasise the effect of sacred space. Temple 3 clearly shows that this system is also used in both indoor and outdoor spaces where the high control d-passage spaces of terrace are surrounded by fragments of c-junction spaces of cloister.

The contemporary Thai temples:
Temple 4's space contains 10 out of 12 structure-experience relations. Like temples 1-3, c-junction relation forms the largest proportion (32%); the difference is that temple 4 does not have cloister space which is closely associated with c-junction relation in the first three temples. Temple 4 is one of many contemporary temples in Thailand that adopts the implication of simplicity and thus the conventional cloister space where the majority of c-junction relation resides is left out. Even so, in this temple c-junction has a relative high integration value (0.727) without actually requiring as large proportion of space as in the conventional temples (Table 5.8). Its effect overlaps with that of d-passage relation since most of the c-junction spaces are on the temple terrace. In this temple, c-junction relation has an effect on the spatial configuration at a larger scale.

The effect of d-passage relation is even more global in temple 4. As a result, for the first time, temple 4's d-passage has a higher mean integration value than d-junction relations which is the reverse of the effects in the space of the conventional temples (Table 5.8). In terms of individual spaces, d-passage space also has the strongest integrated effect at space 5 (1.015). The proportion of d-passage is about twice as large as that of d-junction space because temple 4's space, even though configured towards simplicity, is not designed to minimise the number of spaces in its structure. Apart from its high integration value, the effect of the passage-based relations in this temple is larger than in

the conventional temples considering both proportion and varieties; temple 4 has 41% of its space as passage-based relations which comprise all a-b-c-d type spaces.

Like temple 2, a-passage relations in temple 4 are used to gain symbolic effects and, unlike temple 2, these spaces are intentionally designed for the temple (spaces 47 and 51 in figure 6.11). This temple employs a similar concept to that of Thai houses' detached units on one big terrace influencing the lowest SLR (1.273) as well as the moderate mean integration value (0.705) and BDF (0.85). This is because there are more isolated sub complexes influence a wider range of integration values. The structures of b-passage, b-junction and a-place spaces are used to provide this effect in temple 4's pavilions and *wihans*. On average, these a-place spaces which are indoor spaces have a moderate mean integration value (0.624) since they are in the locations that are highly accessible and visible from the terrace. From the analysis of temple 4, we begin to see not only the continuity but also the shift in the design of Thai temples. a-junction and d-place relations continue to provide symbolic effects with low integration while c- and d-junction relations start to be submerged into the greater simplicity and openness of passage-based relations.

Temple 5 is a dead-end or b-type complex since it has only one connection to the exterior which is unusual for a Thai temple. Because of its compactness, the structure of temple 5 has the highest ratio of links to spaces in the selected contemporary temples (1.329). The depth of temple 5's structure seems to cause more differences in the integration values of its spaces (Figure 6.12) and the lowest BDF value (0.847) in the selected contemporary temples. To deal with its complexity at a large scale, the temple has its largest proportion of space as c-passage space (28%) while the highest mean integration value is in d-passage relations (0.788). In temple 4, spaces 86 and 96 are d-passage spaces that have the highest integration value (1.005) with second highest connectivity (7) and high control value (2.393).

Similar to temple 4, temple 5 strongly suggests the shift from the junction-based relations in conventional design to passage-based relations in contemporary design as it has the largest proportion of d-passage space of all selected temples (19%). This seems to suggest a dynamic effect delivered via relations such as the symbolic a-junction or d-place. So far a-junction has consistently appeared in all selected Thai temples in the same

way as a-place relation has in all selected Thai houses. a-place relation is also present in temple 5 with exceptionally high mean integration value for the relation (0.763). Spaces 39 and 48 are designed to be highly accessible and visible from major passage-based spaces on the terrace. These spaces attract movement and seem to reverse the a-place effect of privacy in houses.

Temple 5 is one of the only three temples that have c-place relation which suggests the effect of privacy at a local scale. The relation is created in spaces 15 and 18 by religious activities and in space 91 by design. Similar to temple 2, c-place spaces in this temple have lower mean integration values than a-place spaces (0.692 and 0.763, respectively). The 'sacred' d-place relation, as usual, is in many important religious spaces and has the lowest mean integration value of all place-type relations in all selected temples (Table 5.8). Relations in temple 5 are strongly configured for various abstract meanings which seem to influence its weak integration values. For example, there are large proportions of a-junction and d-place, the increasing depth and complication of overall structure (highest SLR, 1.329) and more fragmented spaces (highest number of spaces, 142).

Temple 6 is an interesting example because of its minimal approach. The temple has nine structure-experience relations with the second highest BDF among the selected temples (0.869) and a very low SLR (1.286) (Figure 6.13). This fact seems to be the result of having very few spaces in the structure thus one space covers more parts than it would in other temples. Of all selected Thai temples, temple 6 is the only one that is dominated by the highly connected d-type space (44%) while the largest part of the building is experienced as junction (51%). The shift from junction to passage-based relations is also present in temple 6 but they are more visible because of their high integration values rather than the sheer number of spaces. This suggests that the passage-based relations have more effects on the temple structure but not on its spatial experience. The largest proportion of space in this temple is d-junction (22%) while the highest mean integration value is d-passage relation (0.765).

In temple 6, the highest integration value is in space 4 (0.815) which is one of the eight d-junction spaces that are located on the terrace space that has10 d-passage spaces. With its emphasis on the integrated roles through a few c- and d-passage spaces (21), temple 6 seems to achieve both flexible and minimal characteristic. Of all selected temples, temple

6 has the largest proportion of a-place relation (6%) such as spaces 10, 12 and 51 which serve religious activities. The first two spaces acquire the relation through the popularity of use unlike space 51 which was designed by the architect. In Thai temples, a-place spaces work as attraction points at a close proximity with the main circulation of movement rather than to define 'privacy' as in Thai houses. d-place relation here has the highest mean integration value among the selected temples (0.734); e.g. the prayer hall (space 18) also has the highest connectivity (10) and control value (7.333). In this way, the sacred spaces are brought closer into the rest of the structure than they were before. Temple 6, therefore, exemplifies the expansive system with an exposed inner core.

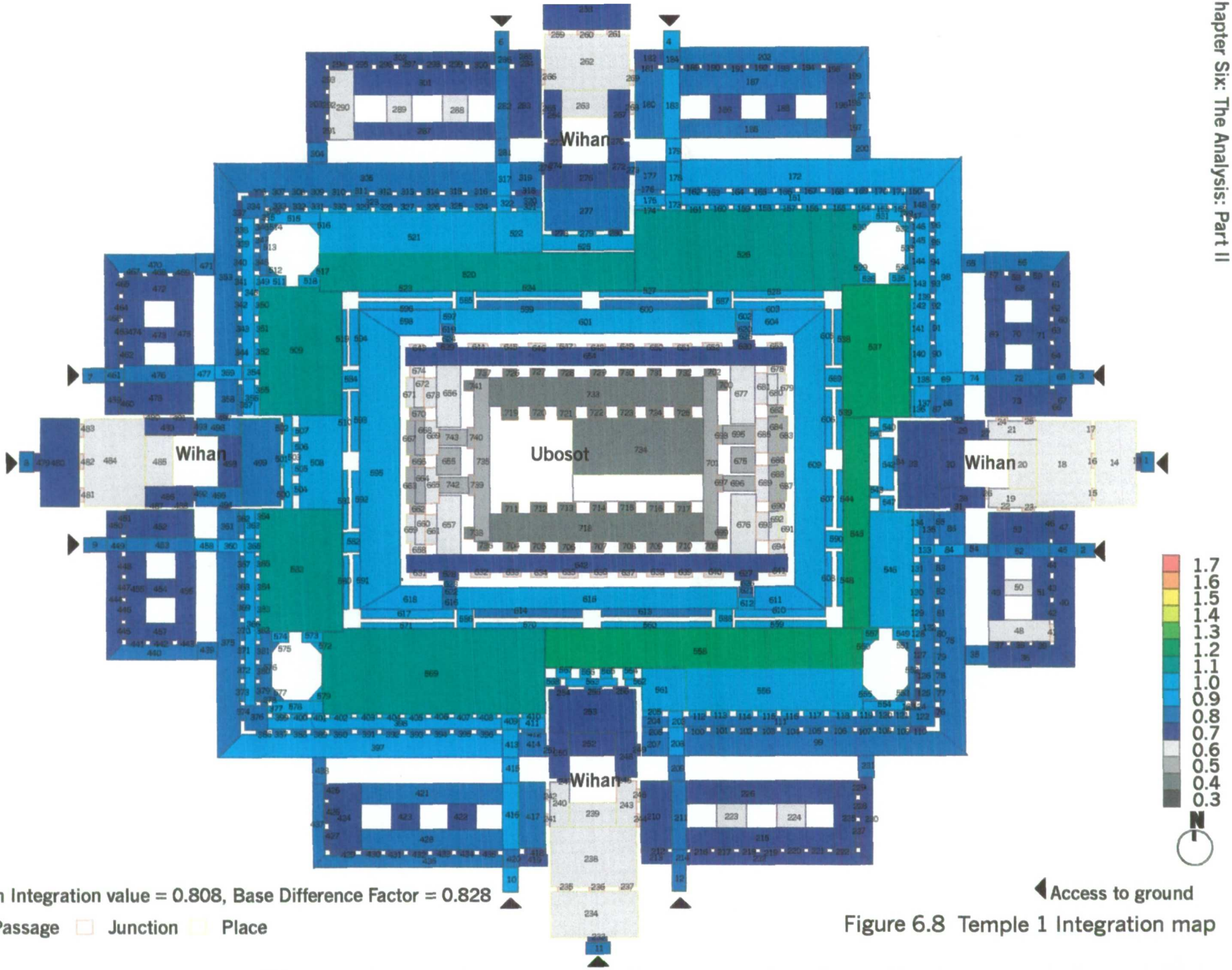
The conclusion

In conclusion, the selected Thai temples seem to be highly homogeneous structures with BDF in the 0.8 scale (Table 6.2). On average, they also have high ratio of links to spaces (1.368). Only temple 2 contains all 12 relations while temples 1 and 3 contain the least (7) (Table 5.8). There are six structure-experience relations appear in every temple: a-junction, c-passage, c-junction, d-passage, d-junction and d-place relations. As seen in houses, a-place, c-junction and d-passage are very important relations in syntactical, theoretical and practical aspects for the selected temples as well. From the calculation, analysis and observation, important structure-experience relations for the selected temple architecture are a-junction, c-junction, d-passage and d-place relations.

Unlike houses, a-type spaces in the selected Thai temples form relations with all experiential types but a-junction is the most certain and significant with 320 spaces in 2369 spaces (11%). Its proportion in all temples is also relatively consistent except in temple 3 where there is no window space which is important for temples not as much for structural as for experiential purpose. Another significant relation in the selected Thai temples is c-junction relation which plays an important role with large proportion (41%) and a high mean integration value (0.709). However, it is clear that its proportion has decreased from 45% in temple 1 to 13% in temple 6 (Table 5.8). d-passage relation is the second largest proportion in the selected temples (14%) and has the second highest mean integration value (0.746). d-junction has the highest mean integration value and seems to define and control the largest open spaces on the terraces of many Thai temples.

The last and the least significant both in number and integration value is the d-place relation. It is the most important in creating an experience of sacredness in temple architecture, Thai and others, since d-place can often be related to congregation spaces in many religions (Davies, 1982). The importance of this relation may lie precisely in its few number of spaces and low integration value. This relation acts as the focus point of other relations and represents the exclusivity of 'sacredness' which is less absolute and more dynamic than the idea of 'privacy' in houses where a-place relation dominates. d-place relations represent about 6% of all temple spaces and have a low integration value (0.601). Through the analyses, these four important relations represent the conception of Thai temples in forms of effects which are precisely 'read and measured' through their numerical and experiential properties.

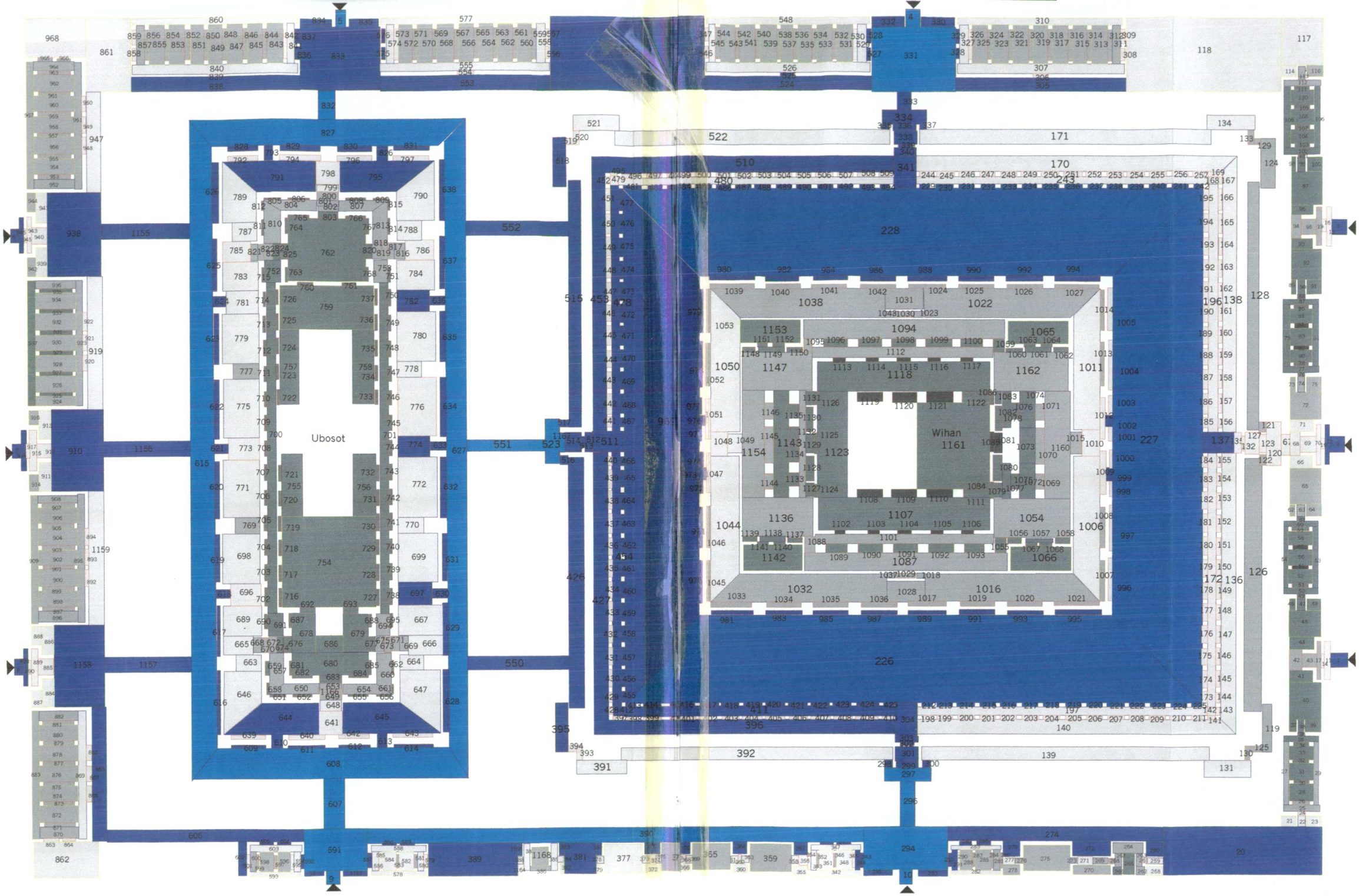
Thai temples have gone through a period of high complexity and absolute sacredness before adopting a more open-plan and minimal concept in contemporary designs. In general, the orientation in Thai architecture has always been towards the dynamic and de-materialistic concepts. These characters are achieved either in a subtle way in conventional cases or in a more literal sense of using fewer architectural elements in contemporary temples. Hypothetical questions of, for example, whether making more dynamic and open-plan temples will make them more or less sacred or how to make spaces which convey certain messages, depend heavily on design. This must encompass the analysis of the functional and architectural element dimensions which are the realisations of effects of structure-experience relations in architectural space.



Mean Integration value = 0.808, Base Difference Factor = 0.828

Passage Junction Place

Figure 6.8 Temple 1 Integration map



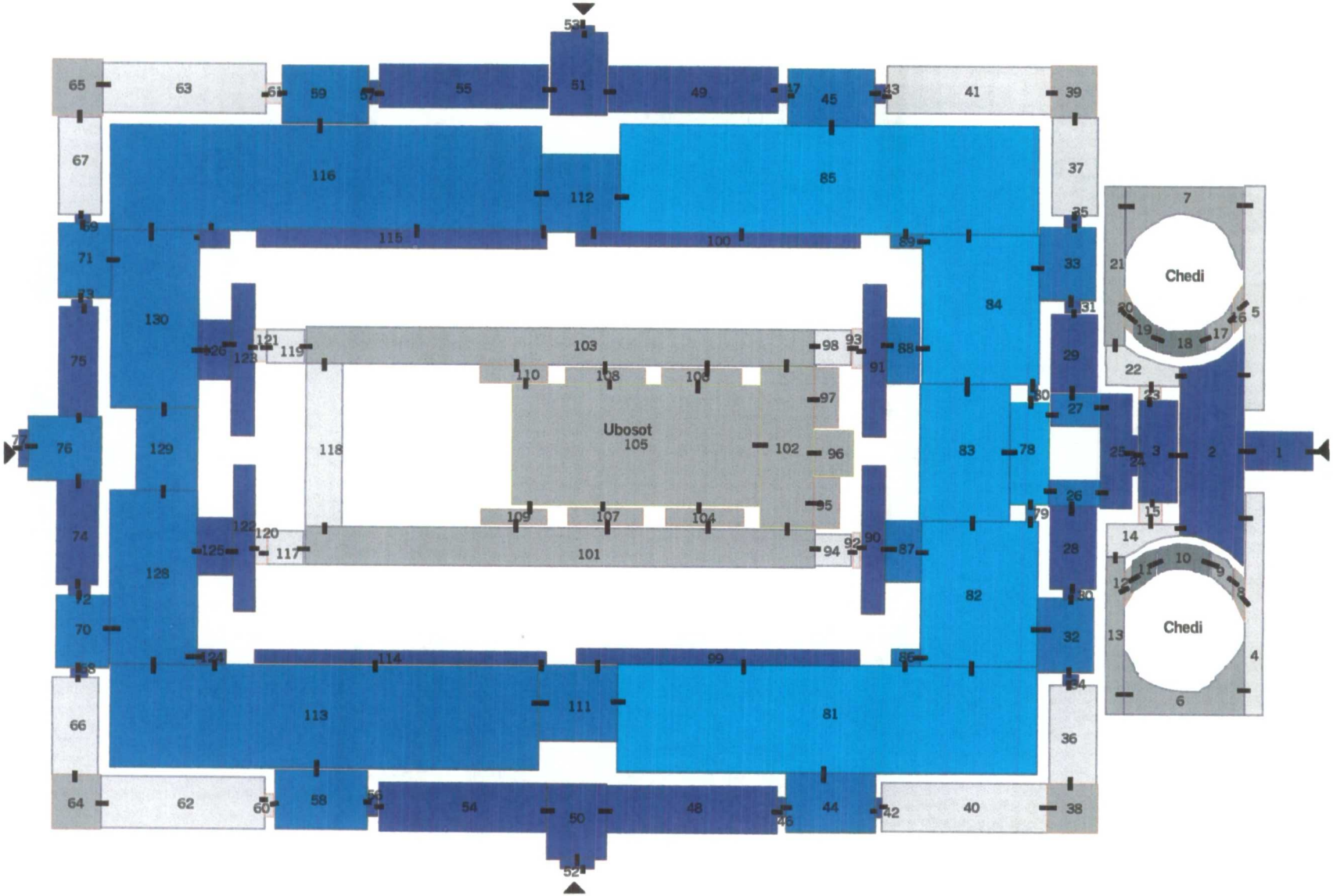
Mean Integration value = 0.604, Base Difference Factor = 0.859

Passage Junction Place

Access to ground

Figure 6.9 Temple 2 integration map

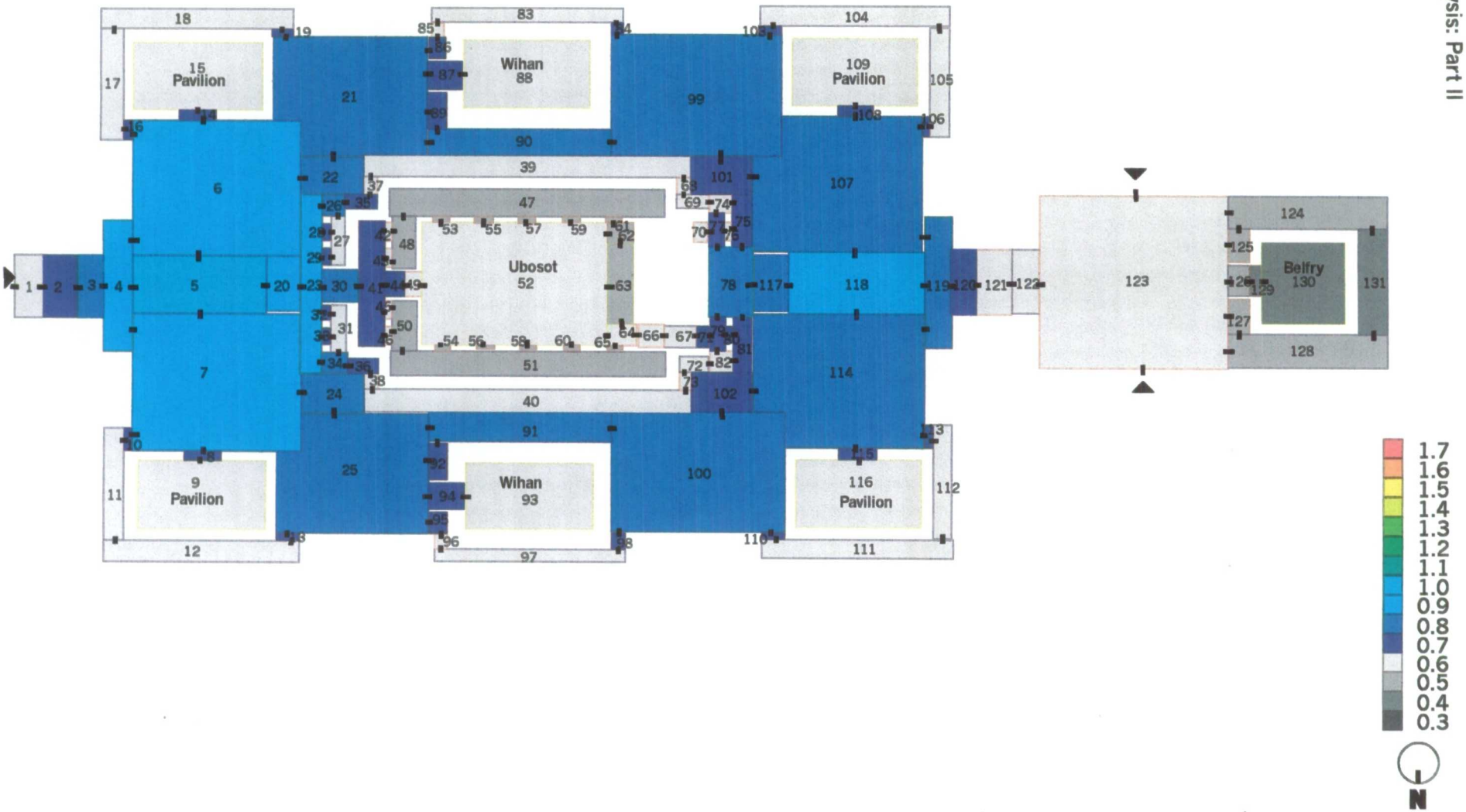
322



Mean Integration value = 0.710, Base Difference Factor = 0.879

Passage Junction Place

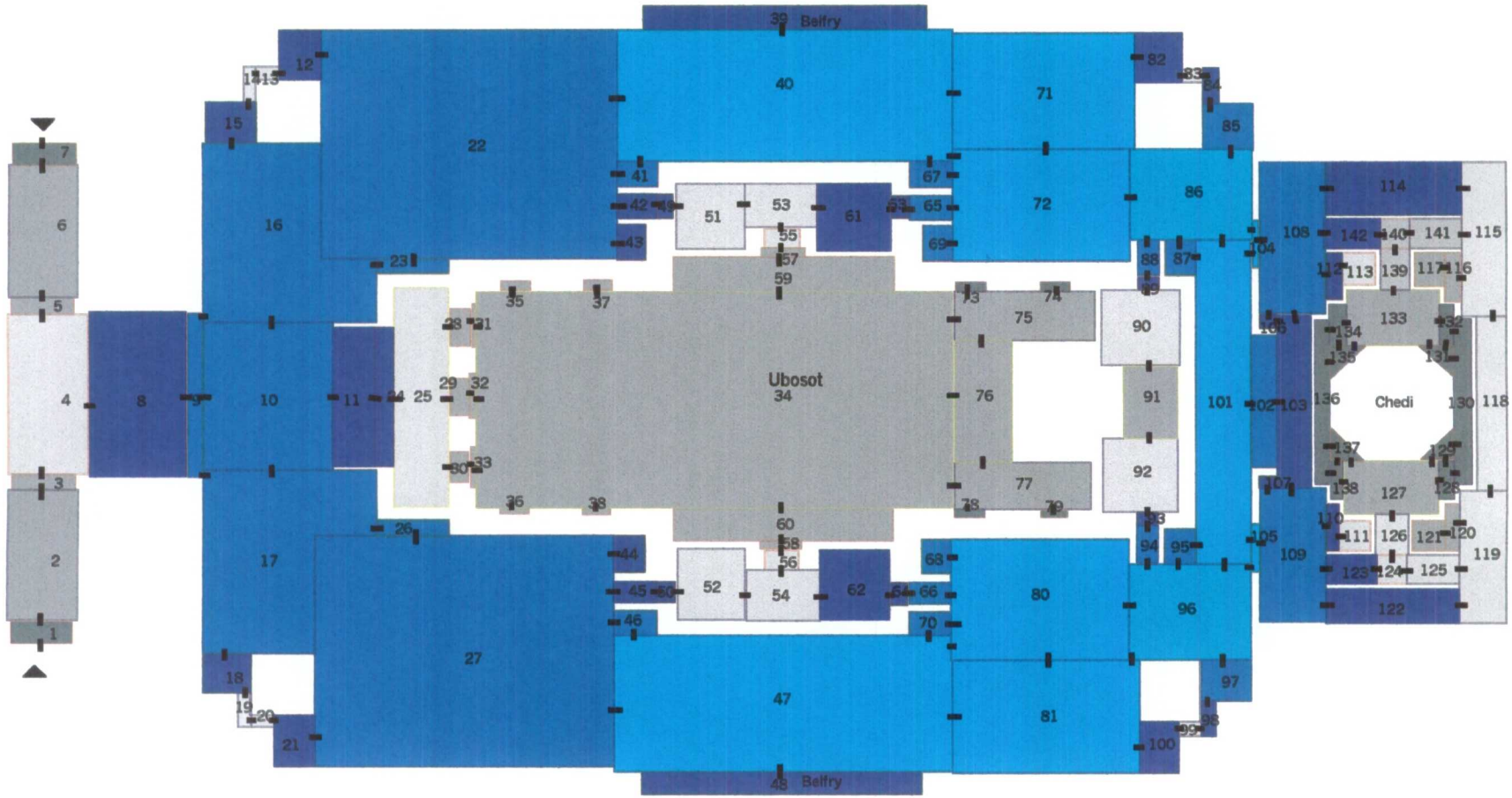
Figure 6.10 Temple 3 Integration map



Mean Integration value = 0.705, Base Difference Factor = 0.850

Passage Junction Place

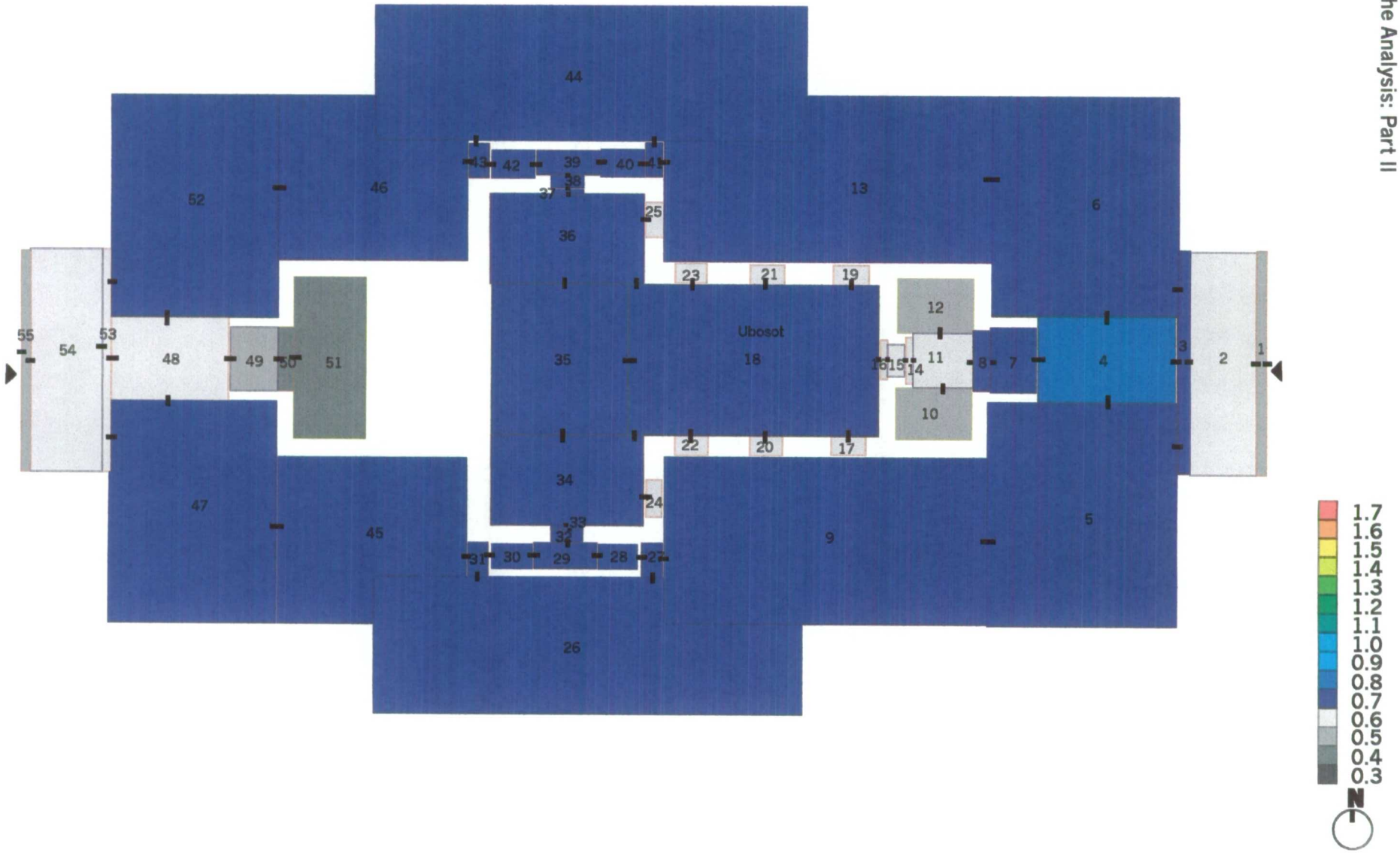
Figure 6.11 Temple 4 Integration map



Mean Integration value = 0.691, Base Difference Factor = 0.847

Passage Junction Place

Figure 6.12 Temple 5 Integration map



Mean Integration value = 0.691, Base Difference Factor = 0.869

Passage Junction Place

Access to ground

Figure 6.13 Temple 6 Integration map

6.2 Design Analysis

Numerical data: Tables 6.3-6.4 (p.328-329), 6.5-6.6 (p.340) and 6.7-6.8 (p.347-351)
Graphical data: Figures 6.14-6.36

Design analysis is the investigation of the functional and architectural-elements dimensions. From the earlier analyses, there are certain structure-experience relations that are crucial to both Thai houses and temples such as c-junction and d-passage relations. At this point, one can differentiate the importance of relations by looking at their structural and experiential properties. For example, even though c-junction is in the majority of space in the selected examples (38%), they have less mean integration value than that of the fewer d-passage spaces (0.715 compared to 0.797). Individual d-passage spaces also tend to have high integration values since they participate extensively in both global and local movements indicating that some of the most constructive spaces are of this type. While c-junction focuses on a local scale, d-passage space holds the whole structure together with a series of experiences, from here to there and back. It is the best space to be in in order to know the whole structure.

The importance of a-place is not shown by its integration value but by its number and most importantly by its functions. a-place is the most certain relation in houses where privacy is the priority. a-junction and d-place relations seem to provide symbolic signification to spaces and thus are very stable in temples but very weak in houses. a-type space is usually the last event in an activity and therefore, it usually represents the best point to look back at the whole. Some of them represent window spaces inside the *ubosot* where people briefly associate with these spaces as junction. a-junction space does not play a great role in the structural dimension but seems to be important in the experiential dimension of Thai temples. In this way, a-junction spaces, either as window or room spaces, help composing the conception of the whole by being either the point to look back on or as the point to go to.

Traditional Thai houses: **Houses 1 – 6**: Functions						
Type	H 1 (35): no. (%)	H 2 (42)	H 3 (61)	H 4 (91)	H 5 (58)	H 6 (53)
bathroom	2 (5.7)	1 (2.4)	1 (1.6)	7 (7.7)	6 (10.3)	8 (**15.1**)
bathing area	-	-	2 (3.3)	-	-	-
bedroom	3 (8.6)	3 (7.1)	10 (**16.4**)	6 (6.6)	6 (10.3)	7 (13.2)
circulation	**18** (**51.4**)	**21** (50)	**22** (36.1)	**35** (38.5)	**20** (34.5)	**14** (26.4)
dayroom	-	-	-	-	-	2 (3.8)
dining hall	-	-	1 (1.6)	-	-	-
dining area	-	-	-	1 (1.1)	1 (**1.7**)	-
dining rm.	-	-	-	-	-	1 (1.9)
dressing rm	-	2 (**4.8**)	-	3 (3.3)	2 (3.5)	-
entrance	3 (8.6)	5 (**11.9**)	4 (6.6)	10 (10.9)	4 (6.9)	2 (3.8)
foyer	-	-	-	7 (7.7)	5 (8.6)	9 (**16.9**)
garden	-	-	-	4 (4.4)	-	-
kitchen	-	1 (**2.4**)	-	1 (1.1)	1 (1.7)	-
living area	9 (25.7)	9 (21.4)	16 (**26.2**)	11 (12.1)	7 (12.1)	-
living rm.	-	-	-	1 (1.1)	2 (**3.5**)	-
pantry	-	-	-	3 (**3.3**)	1 (1.7)	-
prayer hall	-	-	1 (1.6)	-	-	-
spirit rm.	-	-	-	-	1 (1.7)	-
storage	-	-	4 (6.6)	2 (2.2)	-	10 (**18.9**)
study rm.	-	-	-	-	1 (1.7)	-
Total type: 20 (100%)	5 (25)	7 (35)	9 (45)	**13** (65)	**13** (65)	8 (40)
Total space = **340** + 6 exterior spaces						

Table 6.3. Functions of Houses 1-6

Traditional Thai temples: **Temples 1 – 6**: Functions						
Type	T 1 (743): no (%)	T 2 (1168)	T 3 (130)	T 4 (131)	T 5 (142)	T 6 (55)
belfry	-	-	-	1 (0.8)	2 (**1.4**)	-
bench	8 (1.1)	-	-	-	-	-
circulation	**628** (84.5)	**746** (63.9)	**118** (**90.8**)	**108** (82.4)	**115** (80.9)	**36** (65.5)
entrance	35 (4.7)	70 (5.9)	8 (6.2)	1 (0.8)	7 (4.9)	4 (**7.3**)
foyer	4 (0.5)	27 (2.3)	3 (2.3)	-	2 (1.4)	2 (**3.6**)
garden	-	51 (4.4)	-	-	-	-
office	-	126 (10.8)	-	-	-	-
orientation	43 (5.8)	32 (2.7)	-	10 (7.6)	8 (5.6)	8 (**14.6**)
prayer hall	9 (1.2)	48 (4.1)	11 (8.5)	7 (**5.3**)	1 (0.7)	1 (1.8)
prayer space	8 (1.1)	19 (1.6)	-	2 (1.5)	7 (4.9)	4 (**7.3**)
rest area	8 (1.1)	22 (**1.9**)	-	-	-	-
storage	-	23 (**1.9**)	-	2 (1.5)	-	-
Total type: 12 (100%)	8 (66.6)	**10** (83.3)	4 (33.3)	7 (58.3)	7 (58.3)	6 (50)
Total space = **2369** + 6 exterior spaces						

Table 6.4. Functions of Temples 1-6

Design analysis provides practical information about each structure-experience relation in the way that it is actually applied into a piece of architecture. It poses further questions; how structure-experience relations are transformed into architectural elements and in what ways they function. Design and route analyses of the selected buildings investigate the socio-cultural factors that influence the character of Thai architecture. In design analysis, the functional and architectural-element dimensions of space in the selected houses and temples will be looked at independently and then at the relations between the two. Furthermore, the relationship between the structure-experience and the function-architectural element relations will be explored in this analysis. They are seen as two independent counterparts in order to establish a clear background for the holistic approach to all dimensions in the relational analysis in chapter seven. There is a total of 20 different functions in the selected Thai houses whilst there are only 10 architectural elements (Tables 6.3 and 6.5). In the selected Thai temples, this proportion is much more compatible, at 12 functions and 11 architectural elements (Tables 6.4 and 6.6). In both Thai houses and temples, the functional dimension is differentiated to a greater degree and can be incorporated into the more rigid architectural-element dimension. In this way, house architecture seems to be more sustainable to various movements of activities than temple architecture, and thus requires more relations putting together.

The functional dimension in the selected Thai houses and temples

Functions in the selected houses are categorised using information from the plans and observations of the actual uses of space, especially where spaces are not divided by physical boundaries. The latter situation plays a significant role in Thai houses since the architecture is largely open-plan, unlike the directional and interlocking western designs. The information from the plans is usually identified with some of the basic functions in houses such as bedroom and bathroom. The function of circulation forms the largest proportion (Figure 6.14) at 38% of the selected houses' spaces (Table 6.3), which is mostly outdoor space on *chan*. In the selected houses, the second most common function is living area (15%) but none in house 6 due to its very compact open space (Figure 6.15). The next largest function is bedroom (10%) followed by entrance (8%) and bathroom (7%) (Figures 6.16-6.18).

The highest number of different functions appearing in one house is 13 in houses 4 and 5, where more functions are introduced by contemporary activities; i.e. fixed dining area,

of functions is five functions in house 1. As in houses 4 and 5, houses 1 and 2 have a similar proportion of functions. House 2 has the largest proportion of space used as entrance while house 1 has the largest amount of circulation space of all selected houses. House 3 has the highest number of bedrooms in its space as the house was designed to accommodate more people than the other houses even though the house contains the lowest proportion of enclosed space (23%). House 6 is the most contrast to house 3; it has the largest proportion of enclosed space such as bedroom and bathroom (53%) but the smallest proportion of open space such as *chan* space (30 %) (Table 5.1).

Fundamentally, the main functions are similar in all Thai houses; their spaces are usually organised around the basic functions of circulation, bedroom, entrance and bathroom. Living area on the terrace is one of the common features in Thai houses (Figure 6.20). Other functions are only in specific houses such as bathing area in house 3, dressing room in houses 2, 4 and 5, garden and living room in house 4, spirit room in house 5 or dayroom in house 6. These special functions are strategically created in these houses to serve particular programmes of activities. In short, the functional dimension of the selected Thai houses is the most expansive dimension compared to other dimensions. Therefore, the concept of this dimension deals with possibilities more than rules in architectural space, especially in houses, thus a large number of relations are created.

In the selected Thai temples, there are 1751 spaces (74%) of which are used for circulation (Figure 6.21). Many parts of a Thai temple function as junction spaces such as entrances, foyers and window spaces which make up about 11% of the selected temples' spaces. They often function as orientation spaces of temples connecting between important functions or between the whole buildings and exterior space (Figure 6.22). This characteristic suggests that functions of circulation, entrance, orientation and prayer hall are constant elements in Thai temples. However, the most important functions in religious architecture are those which construct the sense of sacredness (Taylor, 1979). In the selected Thai temples, there are about 5% of functions related to 'sacredness' which comprise 117 spaces of prayer hall (3%) and prayer space (2%). Altar may be the most sacred 'element' in a temple but the prayer hall, or sometimes prayer space, is the most sacred 'function' in religious activities (Figure 6.23).

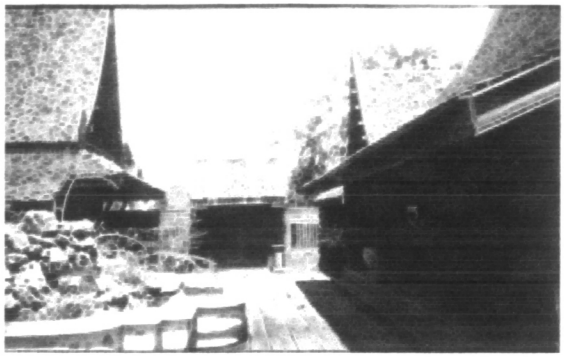
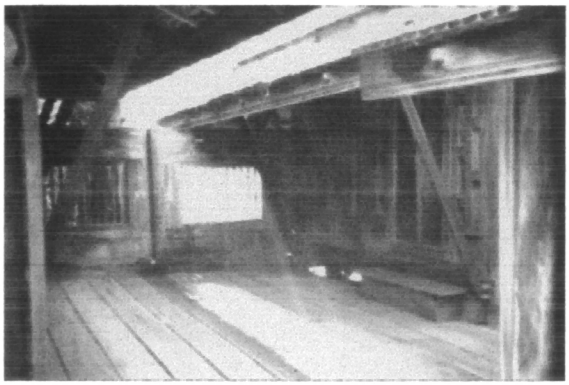


Figure 6.14



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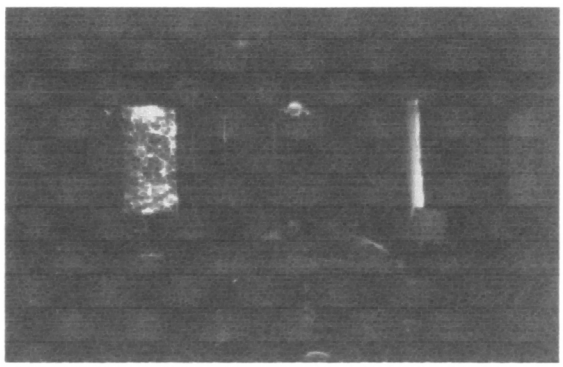
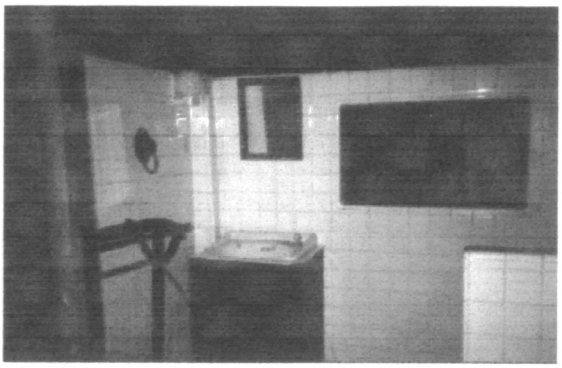


Figure 6.16

Figure 6.17



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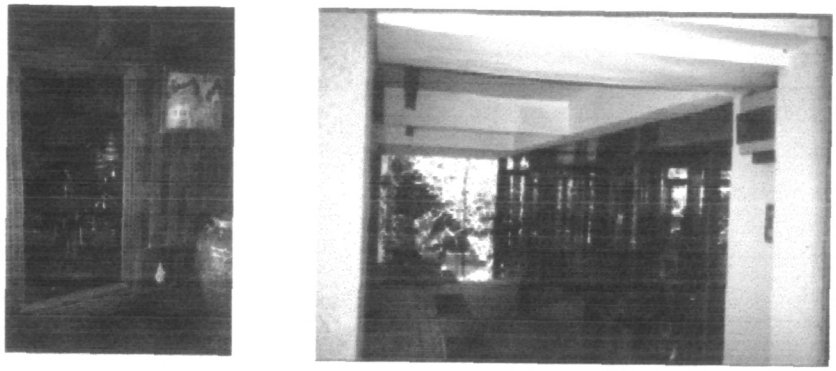


Figure 6.19

Figure 6.20

Figure 6.21

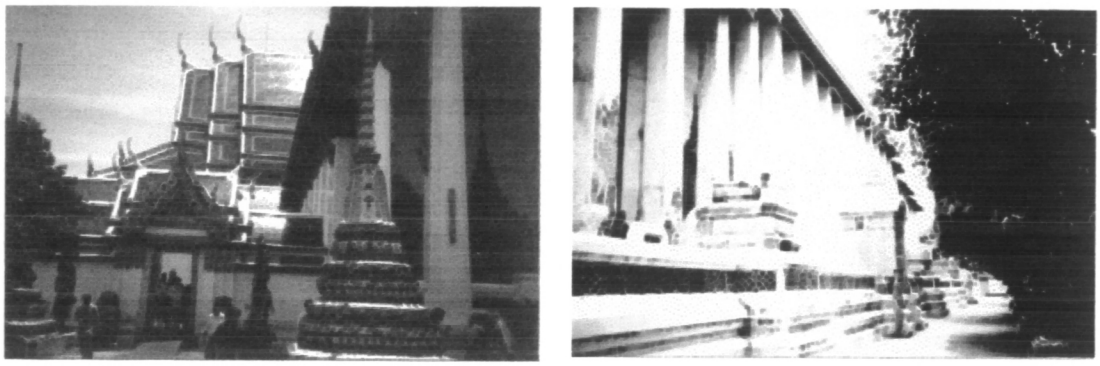


Figure 6.22

Figure 6.23

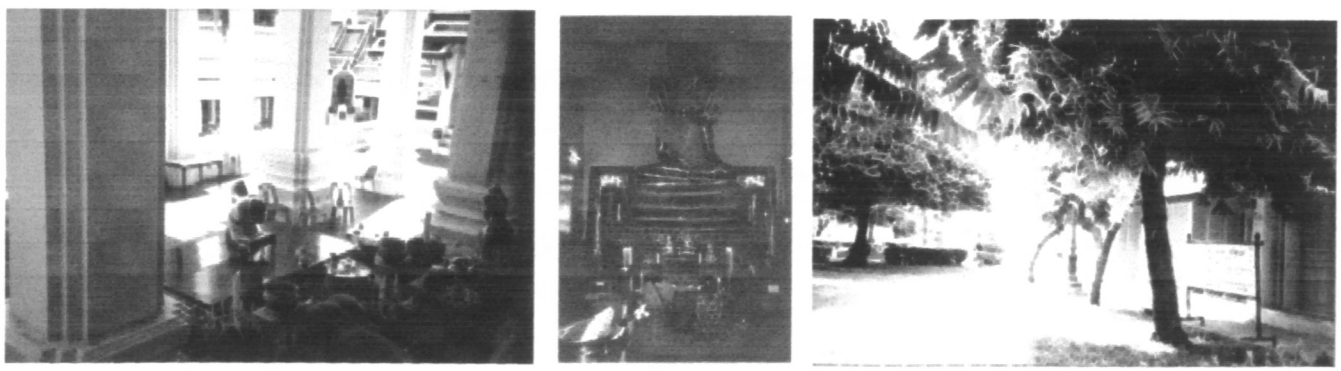


Figure 6.24

Temple 2, the biggest temple, has the highest number of functions (10). Temple 3, the smallest, has the least, only 4 functions in its 131 spaces. However, temple 3 has the highest proportion of circulation space (91%) while temple 2 has the lowest (64%). All selected temples, except temples 2 and 6, have more than 80% of space used for circulation (Table 6.4). Temple 1 has second highest percentage of circulation (85%) and eight different functions; four of them serve 'static' functions that is bench, prayer hall, prayer space and rest area (Figure 6.24). These functions relate to specific leisure, religious and monks' activities respectively. Among 12 functions in the selected Thai temples, functions like bench, garden, office and rest area reflect the concept of temples as not only religious centres but also cultural centres of the community. This concept is strongly emphasised in conventional temples where the monastery yard holds various cultural functions leaving the temple complex as the symbolic centre of the compound, as in the case of temple 3 (Figure 6.25).

Temples 4, 5 and 6 are all contemporary temples where space is not so strongly engaged in other cultural events as in conventional ones. Consequently, these temples become more and more objects of pure symbolic meaning. Temples 4, 5 and 6 have consistent categories of functions that could be easily grouped into two experiences which are the everyday and the religious functions. Furthermore, in contemporary Thai temples the *ubosot* spaces are more integrated and accessible to the outdoor spaces than in conventional cases. As a result, the proportion of religious-related functions, i.e. orientation, prayer hall and prayer space which are mainly indoor functions, is larger in contemporary temples than in conventional ones (Figure 6.26). For example, the average proportion of the above-mentioned functions in temples 1, 2 and 3 is about 8% while it is more than 10% up to 24% in temples 4, 5 and 6 (Table 6.4).

In conclusion, the functional dimension in Thai temples is much more focused than in houses. It therefore deals with rules more than possibilities as in the house cases. These rules are enforced by type and location of the functions whether they are religious-related, usually indoor spaces (e.g. prayer hall) or everyday ones (e.g. circulation or entrance). The most consistent functions in the selected Thai temples, as a building and as a religious centre, are circulation, entrance, and prayer hall suggesting a more rigid and stronger experience of passage, junction and place than in houses. Other consistent functions in the selected Thai temples are foyer, orientation and prayer space. In short, a

Thai temple's functions are mainly applied in space by a strictly laid out design that gradually has become a standard. In comparison to houses, there is little flexibility in temple space where functions can be evolved outside what is already determined in its architectural design. The conventional Thai temples were designed to be the absolute centre of every activity while the contemporary temples become only the centres of special activities and more flexible to various activities.

At this stage, the research proposes that relations in architectural space are the answer to questions of design which is applied in reality through design strategies. It is argued that the designer's approach is needed in order to 'synthesise' rather than 'analyse' the architectural reality in this way. Therefore, at this point of the analysis the paradigm has shifted from a functional-based, i.e. permeability of space in social activities, to an object-based paradigm in architects' design activity. Meaning and form are the primary concerns for the following analyses in order to postulate the effects produced by relations in architectural space, e.g. the sacredness in temples and privacy in houses. In chapter seven, the full discussion of the complete relational syntax will draw upon architectural reality in order to interpret and synthesise the findings. Before that, the analysis will be made on the architectural-element dimension of space which marks both the end and the beginning of architectural space.

Figure 6.25

Figure 6.26

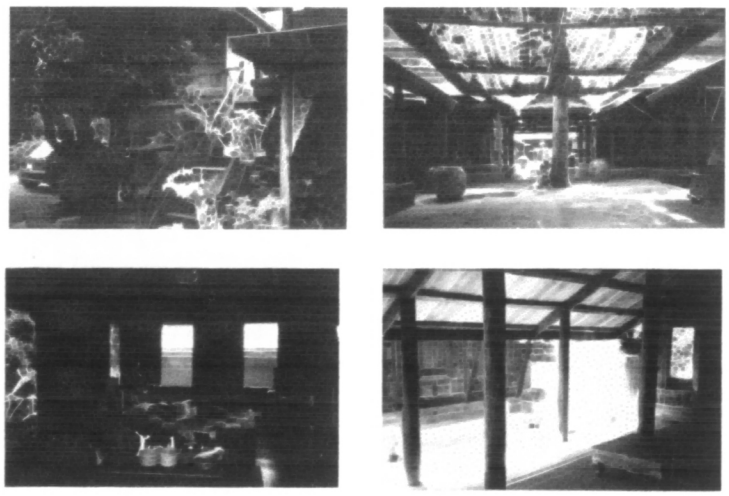


Figure 6.27

338

Traditional Thai houses: **Houses 1 – 6**: Architectural elements						
Type	H 1 (35): no (%)	H 2 (42)	H 3 (61)	H 4 (91)	H 5 (58)	H 6 (53)
courtyard	-	-	-	19 (20.9)	**16 (27.6)**	-
doorway	**9 (25.7)**	5 (11.9)	-	-	-	2 (3.8)
gateway	-	-	-	1 (1.1)	-	-
hall	3 (**8.6**)	1 (2.4)	1 (1.6)	-	-	-
hallway	-	-	-	2 (2.2)	-	-
pavilion	1 (2.9)	**1 (4.8)**	1 (1.6)	-	1 (1.7)	-
room	5 (14.3)	7 (16.7)	12 (19.7)	27 (29.7)	**23** (39.7)	**28 (52.8)**
stairs	7 (20)	10 (**23.8**)	9 (14.8)	8 (8.8)	7 (12.1)	5 (9.4)
terrace	7 (20)	**14** (33.3)	**21 (34.4)**	**30** (32.9)	8 (13.8)	3 (5.7)
veranda	3 (8.6)	3 (7.1)	17 (**27.9**)	4 (4.4)	3 (5.2)	7 (13.2)
Total type: 10 (100%)	**7** (70)	**7** (70)	6 (60)	**7** (70)	6 (60)	5 (50)
Total space = **340** + 6 exterior spaces						

Table 6.5. Architectural elements of Houses 1-6

Traditional Thai temples: **Temples 1 – 6**: Architectural elements						
Type	T 1 (743): no (%)	T 2 (1168)	T 3 (130)	T 4 (131)	T 5 (142)	T 6 (55)
cloister	328 (**44.2**)	234 (20)	50 (38.5)	-	-	-
courtyard	52 (6.9)	180 (**15.4**)	13 (10)	6 (4.6)	-	-
doorway	36 (4.9)	70 (**5.9**)	4 (3.1)	5 (3.8)	5 (3.5)	3 (5.5)
gateway	32 (4.3)	62 (5.3)	8 (6.2)	1 (0.8)	7 (4.9)	4 (**7.3**)
hall	1 (0.1)	3 (0.3)	8 (6.2)	4 (3.1)	4 (2.8)	4 (**7.3**)
hallway	18 (2.4)	15 (1.3)	9 (**6.9**)	-	2 (1.4)	-
pavilion	-	24 (**2.1**)	-	1 (0.8)	-	-
room	32 (4.3)	221 (**18.9**)	-	6 (4.6)	-	-
stairs	12 (1.6)	49 (4.2)	14 (10.8)	15 (11.5)	23 (16.2)	12 (**21.8**)
terrace	188 (25.3)	278 (23.8)	24 (18.5)	83 (63.4)	93 (**65.5**)	24 (43.6)
window	44 (5.9)	32 (2.7)	-	10 (7.6)	8 (5.6)	8 (**14.6**)
Total type: 11 (100%)	10 (90.9)	**11** (100)	8 (72.7)	10 (90.9)	7 (63.6)	6 (54.6)
Total space = **2369** + 6 exterior spaces						

Table 6.6. Architectural elements of Temples 1-6

The architectural-element dimension in the selected houses and temples

The definitions given to architectural elements are derived from common understanding of a building's parts such as rooms, stairs, windows etc. The architectural-element dimension deals with objects in the sense of 'how it is made' rather than 'why it is there' in the abstract sense of functions. Therefore, this dimension is not concerned about possibilities or rules but significance in space and the way architectural qualities of matter are achieved. However, the dimension is closely related to other dimensions, especially with the functional dimension; each element is defined by the way it is used and conceived in reality. For example, a doorway 'connects' two different functions which are in close proximity to each other whilst a gateway 'marks' two or more different zones which are extended beyond the instant interactions of movement in current activities.

The selected Thai houses

There are 10 architectural elements in the selected Thai houses. No house has all 10 elements; the maximum is 7 in houses 1, 2 and 4 down to 5 elements in house 6. As fundamental as the functions of living and circulation, room and stairs are the basic architectural elements that complete house architecture. In the selected Thai houses, room, stairs, terrace and veranda are the most consistent elements that appear in every house (Figure 6.27). Pavilions are used in four out of six houses (none in houses 4 and 6) while doorways are heavily emphasised in houses 1, 2 and 6 and halls appear only in conventional houses. The largest in proportion and the most common architectural element in the selected houses is 'room' (30% or 102 in 340 spaces). Another distinct element is 'terrace' (24%); 'stairs' is the next largest (14%) followed by 'veranda' (11%).

A Thai house has an average of 30% indoor space mainly un-partitioned rooms (Figure 6.28). In each house the proportion of rooms can be as low as 14% in house 1 or as high as 53% in house 6. House 1 has the highest number of strongly emphasised doorways (Figure 6.29). House 2 has the highest number of stairs compared to other houses but terrace is the most common element in house 2 (Figure 6.30). House 3 has the largest proportion of terrace (34%) and veranda (28%) which are the characteristic elements of Thai houses (Figure 6.31). The proportion of terrace decreases in the selected contemporary Thai houses to only about 6% in house 6 (Table 6.5). Houses 4 and 5 have introduced the new element, courtyard, in order to incorporate the ground floor space into the architecture (Figure 6.32).

Figure 6.28

Figure 6.29

Figure 6.30

Figure 6.31

Figure 6.32

Figure 6.33

House 6 has the least number of architectural elements (5) since its design is very compact. However, the amount of convex space that signifies proportions of different architectural elements, as with functions, does not reflect the actual area but the spatial organisation which is people's conception as to what a house is about as an occupiable object. In conclusion, the most influential architectural elements in the selected Thai houses are room, stairs, terrace and veranda (30, 14, 24 and 11%, respectively). It is noticeable that where these elements are concerned architecture can be very flexible since they suggest neither segregation in b-type spaces nor in the sense of a passage that leads to a dead end. Moreover, elements such as simple rooms and a series of open spaces such as terraces and verandas usually suggest possibilities in the functional dimension. These elements will be seen in action in the analysis of routes.

The selected Thai temples

There are 11 architectural elements in the selected Thai temples. In comparison to functions, the fewer varieties of architectural elements in Thai houses and temples suggest that they do not depend on chance or possibilities but on a rigid system and a limited number of known elements. There also seems to be more elements 'invented' for temples than for houses even though temples have fewer functions. In this way, complication can mean fewer possibilities of activity and thus a more focused and specific design strategy for the concept of sacredness in religious architecture. The selected Thai temples contain 2369 spaces and 11 architectural elements (Table 6.6). Temple 2 has 11 architectural elements for its 10 functions while temple 6 has the least, 6 elements for its 6 functions. The most contrast ratio is 8 architectural elements for 4 functions in temple 3. It seems that, Thai temples have many 'ways' to hold their functions, however, in specific rules whilst Thai houses have fewer elements for many more functions to happen in a less rigid way.

The most numerous elements is terrace (690). 29% terrace, 26% cloister and 11% courtyard combine as open space of the selected temples (66%) which is much larger than the open spaces of the selected houses (15%). However, in the contemporary Thai temples there are hardly any courtyards and no cloisters at all which is compensated by a larger proportion of terrace than those in the conventional temples. As a result, terrace is undisputedly the most stable element in Thai temples especially in contemporary ones. The contemporary Thai temples have an average of 61% terrace space while the

conventional temples have only 24%. In place of cloister, open space of terrace can also be configured to provide segregation such as in temple 4 (Figure 6.33).

Other consistent elements in Thai temples are (passage-oriented) stairs, (junction-oriented) doorway and gateway and (place-oriented) hall (Figure 6.34). Stairs represent about 5% while doorway and gateway both represent about 10% on average in all temples. The most significant architectural element in a Thai temple is 'hall' especially when it is used as prayer hall but it represents only 1% of all the space. Next to the hall space, windows work as the most visible links between the sacredness inside the *ubosot* and the rest of the complex (Figure 6.35). Temple 3 does not have any windows while it is 15% in temple 6 where strong permeability is achieved with the highest proportion of gateway (7%), stairs (22%) and hall (7%). Temples 4 and 5 have the largest proportions of terrace; Thai temples retain sacredness by means of open space rather than with physical elements (Figure 6.36).

In conclusion, architectural elements of Thai temples are more specific and fixed to the functions they perform than those in Thai houses. Terrace, doorway, window and hall seem to be the most important elements that form basic characters of a Thai temple. Cloister is only important in conventional temples and has been completely taken over by terrace in contemporary temples. It seems that fewer architectural elements are used to produce the same effects in space of both the contemporary Thai houses and temples. However, this reductive concept is more obvious in the selected temples than in houses through the more considerable decreasing in size and number of elements. Even though there are fewer means or significance in architectural space, Thai temples and houses still retain their identities of being sacred or private through the relations of meaning and form. Architecture, regardless of origin, always communicates any abstraction in design through the concrete of use and object. Further investigation into the function-architectural elements relations will form the conclusion of the effects that make architectural space of users and architects.

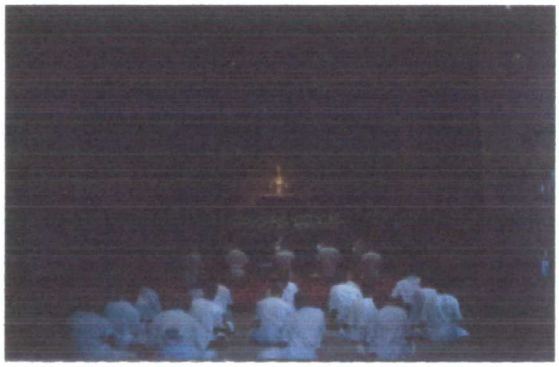


Figure 6.34

Figure 6.35

Temple 1

Temple 2

Temple 3

Temple 4

Temple 5

Temple 6

Figure 6.36

Traditional Thai houses: **Houses 1 – 6**: Function-Architectural-element relations														
Relation (42)	H 1-6 (340)		H 1 (35)		H 2 (42)		H 3 (61)		H 4 (91)		H 5 (58)		H 6 (53)	
	No. (%)	Mean int	No. (%)	Mean int										
bathroom-room	25 (7.4)	0.689	2 (5.7)	0.635	1 (2.4)	0.640	1 (1.6)	0.950	7 (7.7)	0.568	6 (10.3)	0.747	8 (15.1)	0.739
bathing area-terrace	2 (0.6)	0.814	-	-	-	-	2 (3.3)	0.814	-	-	-	-	-	-
bedroom-room	35 (10.3)	0.694	3 (8.6)	0.610	3 (7.1)	0.653	10 (1.6)	0.872	6 (6.6)	0.673	6 (10.3)	0.697	7 (13.2)	0.506
circulation-courtyard	28 (8.2)	0.908	-	-	-	-	-	-	13 (14.3)	0.846	9 (15.5)	0.968	6 (11.3)	**0.954**
circulation-doorway	14 (4.1)	0.841	9 (25.7)	0.849	5 (11.9)	0.827	-	-	-	-	-	-	-	-
circulation-hallway	1 (0.3)	0.591	-	-	-	-	-	-	1 (1.1)	0.591	-	-	-	-
circulation-room	1 (0.3)	0.677	-	-	-	-	-	-	1 (1.1)	0.677	-	-	-	-
circulation-stairs	29 (8.5)	0.91	4 (11.4)	0.795	5 (11.9)	0.977	5 (8.2)	0.971	4 (4.4)	**0.921**	6 (10.3)	0.999	5 (9.4)	0.760
circulation-terrace	**53** (15.6)	1.027	5 (14.3)	**1.041**	**11** (26.2)	1.153	**13** (21.3)	1.276	**16** (17.6)	0.794	5 (8.6)	1.030	3 (5.7)	0.703
circulation-veranda	4 (1.2)	0.849	-	-	-	-	4 (6.6)	0.849	-	-	-	-	-	-
dayroom-room	2 (0.6)	0.845	-	-	-	-	-	-	-	-	-	-	2 (3.8)	0.845
dining area-courtyard	9 (2.7)	0.968	-	-	-	-	-	-	-	-	1 (1.7)	0.927	-	-
dining area-room	1 (0.3)	0.850	-	-	-	-	-	-	1 (1.1)	0.850	-	-	-	-
dining hall-pavilion	1 (0.3)	**1.282**	-	-	-	-	1 (1.6)	1.282	-	-	-	-	-	-
dining room-room	1 (0.3)	0.589	-	-	-	-	-	-	-	-	-	-	1 (1.9)	0.589
dressing room-room	7 (2.1)	0.566	-	-	2 (4.8)	0.553	-	-	3 (3.3)	0.562	2 (3.5)	0.589	-	-
entrance-courtyard	5 (1.5)	0.907	-	-	-	-	-	-	3 (3.3)	0.731	2 (3.5)	**1.172**	-	-

entrance-doorway	2 (0.6)	0.936	-	-	-	-	-	-	-	-	-	-	2 (3.8)	0.936
entrance-gateway	1 (0.3)	0.642	-	-	-	-	-	-	1 (1.1)	0.642	-	-	-	-
entrance-stairs	17 (5)	0.865	3 (8.6)	0.793	5 (11.9)	0.898	4 (6.6)	0.849	4 (4.4)	0.841	1 (1.7)	1.084	-	-
entrance-terrace	3 (0.9)	0.722	-	-	-	-	-	-	2 (2.2)	0.762	1 (1.7)	0.642	-	-
foyer-courtyard	3 (0.9)	0.852	-	-	-	-	-	-	-	-	1 (1.7)	0.781	2 (3.8)	0.888
foyer-room	4 (1.2)	0.78	-	-	-	-	-	-	2 (2.2)	0.632	2 (3.5)	0.928	-	-
foyer-terrace	2 (0.6)	0.633	-	-	-	-	-	-	2 (2.2)	0.633	-	-	-	-
foyer-veranda	12 (3.5)	0.676	-	-	-	-	-	-	3 (3.3)	0.725	2 (3.5)	0.878	7 (13.2)	0.597
garden-terrace	4 (1.2)	0.682	-	-	-	-	-	-	4 (4.4)	0.682	-	-	-	-
kitchen-room	3 (0.9)	0.818	-	-	1 (2.4)	0.663	-	-	1 (1.1)	0.798	1 (1.7)	0.992	-	-
living area-courtyard	5 (1.5)	0.804	-	-	-	-	-	-	2 (2.2)	0.778	3 (5.2)	0.822	-	-
living area-hall	4 (1.2)	0.764	3 (8.6)	0.741	1 (2.4)	0.834	-	-	-	-	-	-	-	-
living area-hallway	1 (0.3)	0.591	-	-	-	-	-	-	1 (1.1)	0.591	-	-	-	-
living area-pavilion	4 (1.2)	0.656	1 (2.9)	0.734	2 (4.8)	0.674	-	-	-	-	1 (1.7)	0.542	-	-
living area-room	1 (0.3)	0.737	-	-	-	-	-	-	1 (1.1)	0.737	-	-	-	-
living area-terrace	16 (4.7)	1.037	2 (5.7)	0.789	3 (7.1)	**1.190**	3 (4.9)	**1.595**	6 (6.6)	0.777	2 (3.5)	1.033	-	-
living area-veranda	21 (6.2)	1.131	3 (8.6)	0.863	3 (7.1)	1.098	**13** (21.3)	1.265	1 (1.1)	0.582	1 (1.7)	0.837	-	-
living room-room	3 (0.9)	0.753	-	-	-	-	-	-	1 (1.1)	0.763	2 (3.5)	0.748	-	-
pantry-courtyard	1 (0.3)	0.609	-	-	-	-	-	-	1 (1.1)	0.609	-	-	-	-
pantry-room	3 (0.9)	0.693	-	-	-	-	-	-	2 (2.2)	0.655	1 (1.7)	0.769	-	-

prayer hall-hall	1 (0.3)	1.132	-	-	-	-	1 (1.6)	1.132	-	-	-	-	-	-
spirit room-room	1 (0.3)	0.675	-	-	-	-	-	-	-	-	1 (1.7)	0.675	-	-
storage-room	13 (3.8)	0.601	-	-	-	-	1 (1.6)	0.671	2 (2.2)	0.730	-	-	**10** (18.9)	0.568
storage-terrace	3 (0.9)	0.908	-	-	-	-	3 (4.9)	0.908	-	-	-	-	-	-
study room-room	2 (0.6)	0.704	-	-	-	-	-	-	-	-	2 (3.5)	0.704	-	-
Total type: 42 (100%)	340	0.860	10 (23.8)		12 (28.5)		13 (30.9)		**26** (61.9)		22 (52.4)		11 (26.2)	
Total space = **340** + 6 exterior spaces														

Table 6.7. Function-Architectural element relations of Houses 1-6

Traditional Thai temples: **Temples 1 – 6**: Function-Architectural-element relations														
Relation (30)	T 1-6 (2369)		T 1 (743)		T 2 (1168)		T 3 (130)		T 4 (131)		T 5 (142)		T 6 (55)	
	No. (%)	Mean int	No. (%)	Mean int										
belfry-pavilion	1 (0.04)	0.448	-	-	-	-	-	-	1 (0.8)	0.448	-	-	-	-
belfry-terrace	2 (0.1)	0.763	-	-	-	-	-	-	-	-	2 (1.4)	**0.763**	-	-
bench-terrace	8 (0.3)	0.573	8 (1.1)	0.573	-	-	-	-	-	-	-	-	-	-
circulation-cloister	606 (25.6)	0.776	**328** (44.2)	0.851	**234** (20)	0.679	**44** (33.9)	0.728	-	-	-	-	-	-
circulation-courtyard	166 (7)	0.721	44 (5.9)	0.785	103 (8.8)	**0.720**	13 (10)	0.590	6 (4.6)	0.558	-	-	-	-
circulation-doorway	123 (5.2)	0.655	36 (4.9)	0.720	70 (5.9)	0.620	4 (3.1)	0.666	5 (3.8)	0.714	5 (3.5)	0.571	3 (5.5)	0.712
circulation-hallway	44 (1.9)	0.474	18 (2.4)	0.471	15 (1.3)	0.408	9 (6.9)	0.581	-	-	2 (1.4)	0.521	-	-
circulation-pavilion	10 (0.4)	0.587	-	-	10 (0.9)	0.587	-	-	-	-	-	-	-	-
circulation-room	16 (0.7)	0.732	16 (2.2)	0.732	-	-	-	-	-	-	-	-	-	-
circulation-stairs	124 (5.2)	0.637	12 (1.6)	0.773	49 (4.2)	0.553	14 (10.8)	0.615	15 (11.5)	0.735	23 (16.2)	0.673	11 (20)	0.676
circulation-terrace	650 (27.4)	0.7	169 (22.8)	0.862	268 (22.9)	0.563	24 (18.5)	0.840	**82** (62.6)	0.739	**85** (59.9)	0.736	**22** (40)	0.695
entrance-gateway	114 (4.8)	0.773	32 (4.3)	0.926	62 (5.3)	0.716	8 (6.2)	0.715	1 (0.8)	0.662	7 (4.9)	0.706	4 (7.3)	0.687
entrance-pavilion	8 (0.3)	0.460	-	-	8 (0.7)	0.460	-	-	-	-	-	-	-	-
entrance-terrace	4 (0.2)	0.767	4 (0.5)	0.767	-	-	-	-	-	-	-	-	-	-
foyer-cloister	3 (0.1)	0.770	-	-	-	-	3 (2.3)	0.770	-	-	-	-	-	-
foyer-hall	4 (0.2)	0.656	-	-	-	-	-	-	-	-	2 (1.4)	0.577	2 (3.6)	0.734
foyer-room	27 (1.1)	0.588	-	-	27 (2.3)	0.588	-	-	-	-	-	-	-	-

foyer-terrace	4 (0.2)	0.701	4 (0.5)	0.701	-	-	-	-	-	-	-	-	-	-
garden-courtyard	51 (2.2)	0.587	-	-	51 (4.4)	0.587	-	-	-	-	-	-	-	-
office-room	126 (5.3)	0.558	-	-	126 (10.8)	0.558	-	-	-	-	-	-	-	-
orientation-window	102 (4.3)	0.52	44 (5.9)	0.565	32 (2.7)	0.429	-	-	10 (7.6)	0.556	8 (5.6)	0.494	8 (14.6)	0.618
prayer hall-cloister	3 (0.1)	0.880	-	-	-	-	3 (2.3)	**0.880**	-	-	-	-	-	-
prayer hall-hall	17 (0.7)	0.657	1 (0.1)	0.489	3 (0.3)	0.432	8 (6.1)	0.650	3 (2.3)	0.613	1 (0.7)	0.584	1 (1.8)	**0.762**
prayer hall-room	57 (2.4)	0.559	8 (1.1)	0.708	45 (3.9)	0.524	-	-	4 (3.1)	0.658	-	-	-	-
prayer space-hall	3 (0.1)	0.583	-	-	-	-	-	-	1 (0.8)	0.521	1 (0.7)	0.521	1 (1.8)	0.706
prayer space-pavilion	6 (0.25)	0.460	-	-	6 (0.5)	0.460	-	-	-	-	-	-	-	-
prayer space-room	8 (0.3)	0.811	8 (1.1)	0.811	-	-	-	-	-	-	-	-	-	-
prayer space-terrace	23 (0.9)	0.604	3 (0.4)	**1.05**	10 (0.9)	0.453	-	-	1 (0.8)	**0.828**	6 (4.2)	0.635	3 (5.5)	0.526
rest area-courtyard	34 (1.4)	0.706	8	0.782	26	0.683	-	-	-	-	-	-	-	-
storage-room	25 (1.1)	0.497	-	-	23 (1.9)	0.484	-	-	2 (1.5)	0.645	-	-	-	-
Total type: 30 (100%)	2369	0.702	17 (56.7)		19 (63.3)		10 (33.3)		12 (40)		11 (36.7)		9 (30)	
Total space = **2369** + 6 exterior spaces														

Table 6.8. Function-Architectural element relations of Temples 1-6

The function-architectural element relations in the selected Thai houses and temples

There are 42 relations between the functions and architectural elements of the selected houses (Table 6.7) which are made from 20 functions and 10 architectural elements (detailed lists for each example in appendix). The dimensions of function and architectural element exist in the way we use and see the buildings. Bedroom, bathroom, circulation, entrance and living area are the influential and consistent functions while room, stairs, terrace and veranda are the architectural elements that characterise the primary features in the selected Thai houses. Space in houses tends to be more flexible for activities than in temples reflecting in the high number of relations and many individual relations that are exclusive to only one or two houses. There are 21 relations that appear in one house only while 7 relations are in two houses only. These exclusive relations make up about 67% of all relations in the selected houses while it is 60% or 18 out of 30 relations in temples. There are 15 relations that appear in one temple only and 3 relations appear in two temples only.

The selected Thai houses

House 1 has the least number of relations (10) while house 4 has the highest (26). Bathroom-room, bedroom-room, circulation-stairs and circulation-terrace relations appear in all houses. The largest relation in number is circulation-terrace (53) with a high integration value (1.027). This relation is theoretically compatible and highly practical making it very strong in all senses; it is very common and dominant in Thai houses' structure and experience. House 2 has the largest proportion of circulation-terrace relation while in house 3 this relation has the highest mean integration value making houses 3 and 2 the highest and second highest integrated (1.078 and 0.944, respectively). House 6 has the least mean integration value of circulation-terrace relation (0.703); the house as a whole also has the least integration value (0.703).

In all selected houses, bedroom-room is the second largest relation (10%) with the largest number in the room-based relations (35). House 6 has the largest proportion of this relation reflecting its concept of compactness. It is clear that the bedroom-room relation is both the symbolic and structural centre of a house and may be said to be the most important one in all regards. Therefore, in the design process the relation is given the highest priority around which other design strategies of house are invented. Other essential relations in all selected houses are bathroom-room and circulation-stairs.

Entrance-stairs, living area-terrace and living area-veranda are characteristic relations for Thai houses; they appear in houses 1-5. The entrance-stairs relation signifies the entry point by a change of material and floor level on a small platform in front of the stairs. The relation has high mean integration value (0.865) which is identified with the concept of junction between two areas. This strategy is also used in other parts of the house such as in living area-veranda which is separated from terrace by the change of material, level and volume of space. Strongest in house 3, both living area-terrace and living area-veranda relations have very high mean integration values (1.037 and 1.131, respectively).

Circulation-courtyard appears only in contemporary houses 4, 5 and 6 while circulation-doorway, living area-hall and living area-pavilion appear only in conventional houses 1 and 2. In conclusion, some relations are intrinsic to the Thai houses such as bedroom-room, bathroom-room and living area-terrace. From the data and on-site observation, there are also other relations that seem to be common to Thai houses such as circulation-terrace, entrance-stairs and living area-veranda. Relations like bedroom-room, bathroom-room or circulation-stairs seem to be common for house architecture in general. As the research progresses, this effect will be rounded up in a full circle of relations, relational syntax. These relations are presented in architecture as the results of specific design strategies and it is possible to differentiate buildings of the same type by looking at the detail information in these relations.

The selected Thai temples

In the selected Thai temples, there are 30 function-architectural element relations (Table 6.8) which are made of 12 functions and 11 architectural elements (Tables 6.8.1-6.8.6 in appendix). Circulation, entrance and prayer hall are very consistent functions for temples while special emphasis is put on the functions of orientation and prayer space because of their symbolic qualities. Gateway, hall, terrace and window are important architectural elements in Thai temples. The relations between the above-mentioned features are highly visible among other relations in table 6.8. The function-architectural element relations in temples are more conformist than those in houses. Of all 30 relations, there are five that appears in all temples (17%) whilst it is only 4 out of 42 relations that appear in all houses. There are 15 relations that appear in only one temple compared to 21 relations in the selected houses suggesting that Thai houses are the architecture of dynamic

possibilities while Thai temples are the architecture of dynamic rules. These effects in Thai houses and temples will be fully discussed as the design strategies used to create them are depicted in multi-dimensional forms of relational syntax in chapter seven.

The range of relations in temples is considerably more coherent than in houses. 19 relations in temple 2 represent 63% of the relations appear in the selected Thai temples while the least is 30% from temple 6's relations, the difference of 27% compared to 28% difference between the highest and the lowest in houses. In this way, temple architecture shares more common features and thus the way they are put together than houses do. The most common relation in all temples contains 650 spaces (28%) of circulation-terrace which has the second highest mean integration value (0.7) among the five most consistent relations. Temple 4 has the largest proportion of circulation-terrace (63%); this relation is larger in contemporary temples than in conventional temples. In short, the circulation-terrace relation is very consistent in space of Thai temples and houses.

Circulation-stairs relation has much less mean integration value in temples (0.637) than in houses (0.91). This relation and circulation-doorway are consistent in all temples and are one of the generic relations in architecture. However, these two relations are differently configured in different types of building such as in houses and temples. For example, the proportion of circulation-doorway is higher in the selected Thai temples than in houses but the relation has less mean integration value in temples. This is because the stronger sense of junction between different zones in a Thai temple is multiplied in more spaces of the same relation. Since Thai temples usually have elaborate design to signify the change of zoning this means that the integration value is reduced in individual spaces.

Entrance-gateway and prayer hall-hall relations are the common relations in Thai temples where gateways have dual identity: the collectors and the segregators of movement. The relation has a high mean integration value (0.773) as a junction and highly symbolic quality. Prayer hall-hall relation is usually at the centre of a temple with the highest symbolic value which is not clearly shown in numerical data except that it always has only a few spaces and a moderate mean integration value (0.657). The importance of the prayer hall-hall relation is in the recognition of place-type and the special activities in religious ceremony that the worshippers recall in their routines and bodily movement.

Other distinct relations in terms of consistency and symbolic value are orientation-window and prayer space-terrace relations which are created by specific design strategies and sometimes unplanned religious activities. Temple 3 is the only temple that does not have these two relations because of its design whereby *ubosot* is completely isolated with no windows. Temple 6 has the largest proportion of orientation-window relation (15%) with the highest integration value in all temples (0.618) suggesting that temple designs become more open from the inside. Prayer space-terrace relation is also becoming more and more common in Thai temples; it is normally in the place where worshippers can pray without going inside the *ubosot*. The prayer space-terrace relation can be very strong such as the one in the Buddhapadipa temple in London analysed in chapter three. Temple 6 has the largest proportion of this relation (6%) while it has the highest integration value (1.05) in temple 1.

Prayer space-hall is the relation in the specially defined space in front of the Buddha image in the *ubosot* for the worshippers to kneel down and pray. This relation is essential in the chapels of most religious architecture where the concept of centre and journey are promoted (Humphrey&Vitebsky, 1997). Temples 4, 5 and 6 each configure this relation in one space of approximately the same size. The relation has no significant figures in terms of number or integration value, but it is the most sacred space inside the *ubosot* that used to be a small altar used mostly by monks in conventional temples. Circulation-cloister relation is exclusive to the selected conventional Thai temples that use cloisters to define sacred area. Architecturally, this relation is in spaces that work as supporting circulation system around terraces. Circulation-cloister relation is dominant in both number and integration value of spaces but only in the conventional temples. Experientially, the relation has a symbolic value that implies segregation but it has high integration value suggesting its dual role similar to that of entrance-gateway. Other relations that seem to associate with conventional Thai temples are circulation-hallway and circulation-courtyard relations.

According to the way we build and use architecture, it seems that there are relations that are generic for buildings across socio-cultural contexts. Circulation-stairs and circulation-doorway are among the most universal relations in most buildings not just in houses. However, relations such as entrance-gateway and prayer hall-hall seem to be more common in religious architecture. There are also the relations that are specific to Thai

temples such as orientation-window and prayer space-terrace. The differences between temples and houses then seem to lie in the detail of generic relations and in the specific relations that appear exclusively for each type. Furthermore, different buildings exist because their spaces are configured with different properties in a variety of proportions. A building therefore communicates in a certain 'way' with its users using certain parts of its structures which are the results of design strategies. These design strategies can either encourage possibilities as in Thai houses or play with rules as in Thai temples; we shall see how these effects are achieved in the next chapter.

At this stage, the argument made so far in the research has been two fold. One is the investigation of architectural space through the natural movement of users of the buildings based mainly on the idea of social activities as the 'architect' of the buildings. Another is the investigation of the physical evidence designed by architects to put together those social activities into an architectural reality. With these two approaches to space, the differences arise between another two approaches to the built environment: house and temple. They create certain relations in their spaces that are configured into deep comprehension comprised of four dimensions of architectural space from both users' and architects' points of view which are socio-cultural sensitive. Therefore, the analysis of Thai houses and temples is superimposed by another two spheres of conventional and contemporary design.

The string of relations deduced from space of the examples therefore does not only present a catalogue of 'types' of architectural language but are the micro systems inscribed in spatial configurations by the social acts of use and design. The important relations found in the above analyses will be further looked at in the next analysis which looks at the main routes where most of important movements in social activities take place in each selected building. These routes do not represent only the most interesting experiences in a building but also the ones that contain the best description of the building as a design object put in place by design strategies made from structure-experience-function-architectural element relations.

6.3 Route analysis

Numerical data: Tables 6.9-6.10 (p.359-360)

Graphical data: Figures 6.37, 6.38-6.43a&b, 6.44, 6.45-6.46a,b&c, 6.47-6.50a&b

We have seen from earlier analyses that there are certain generic relations in space that define each type of architecture as well as specific relations that differentiate one building from other. These relations apply to the whole of architecture in the same way as Cassirer's 'constitutive conditions' of point, line and plane apply to pure space (1955:88). The particular configurations of these relations seem to be the main factor of how architecture is understood as socio-cultural object in actual use not just a complex spatial form. As a building is used for specific purposes, certain parts that involve in such activities will create the specific pictures of that building through which the users form their basic understandings of the architecture. This understanding rarely represents the whole enterprise of the architect's design but usually only the most significant parts of the design. Social activities determine these routes of movement in users' experience as well as in architects' design.

Route analysis is a step towards the understanding of design strategies in architecture by looking at the major parts of a building in real use. This sequential approach to space is mutually adopted by designers and users when they conceive a building. From the time of its conception, architectural space forms its dimensions through use and in this way users become the architects of a building by either confirming the exact relations in the building's spaces or revising and creating new ones. To understand how a building operates in conjunction with people's conception of its design, on-site observations are needed in order to pinpoint specific parts which are the best representative of what such place and use are about. In reference to the whole buildings, three routes are selected based on their popularity, efficiency of movement and significance of the architectural features. In this way, significant relations in these significant routes will be pointed out.

Architecture is experienced in parts but understood as a whole discourse. The knowledge of the whole building in one's experience is constructed on specific sets of experience through their narrative quality (Barthes, 1977). The organisation of the whole, building space or discourse, is intrinsically reflected through the concrete configuration of the important elements in these main routes. Consequently, the criteria for selecting routes in

the selected examples are based on three aspects. Firstly, the route has to efficiently represent thorough experience of the building. Secondly, it has to be the major part of the most frequently used space in the basic activities in the building. Thirdly, the route has to involve with both the most significant and basic architectural features of the design in the building.

Route intrinsically implies narration and rhetorical meaning in experience which is 'opaque' in architectural elements while in words it is 'transparent' (Eisenman, 1987). Route analysis joins users' and architects' paradigms through the interplay of opacity of architectural elements and the transparency of the words that describe function of the space. That is why, the selecting criteria above are based on both functions and architectural features of the building. And as Barthes suggested, there are three levels of description in narration works: levels of functions, actions and narration (1977). Barthes's 'function' structures 'meaning' which is experienced as 'action' in activities through the medium of 'narration' before arriving at a discourse. In this way, the narration of the multi-dimension in architectural space (discourse) is the relation of structure (function)-experience (action)-function (meaning)-architectural element (narration).

As seen in earlier analyses, houses are structured toward privacy and temples sacredness. The difference is mainly that houses are about possibilities in space and thus the identity of a house, especially a Thai house, is structured by 'through' movements which offer the way to go around without interfering with privacy. On the other hand, temples are about destination and rules in movement. Important routes in temples are then usually structured by 'from-to' movements which are heavily oriented around the *ubosot*. Therefore, the main routes usually lead to this centre or around it. The on-site observation is employed to identify these routes according to this concept and to verify that they are used accordingly in real activities and as it is meant in design.

Traditional Thai house: **Houses 1- 6**: Route analysis							
Route 1 (front-to-back, red)							
	H 1-6 (340)	H 1 (35)	H 2 (42)	H 3 (61)	H 4 (91)	H 5 (58)	H 6 (53)
No. of space	65 (19.1%)	12 (**34.3**)	9 (21.4)	11 (18.0)	9 (9.9)	**13** (22.4)	11 (20.8)
Mean Int/ Control value	1.002/1.219	0.949/1.08	1.182/1.299	**1.265**/1.323	0.731/0.909	1.018/0.756	0.864/**1.948**
Adjacent space/ mean connection	37 (mean) /3.5	34/2.8	32 /3.6	**52/4.7**	29 /3.2	39 /3.0	37 /3.4
High relations	10 d-pa-circulation-terrace	3 d-pa-cir-terrace, c-pa-cir-stairs	3 d-pa-circulation-terrace	**4** d-pa-circulation-terrace	2 c/d-pa/d-ju-cir-courtyard	3 c-pa-circulation-stairs	3 c-pa-circulation-courtyard
Route 2 (front-to-service, blue)							
No. of space	61 (17.9%)	**12** (**34.3**)	9 (21.4)	11 (18.0)	11 (12.1)	7 (12.1)	11 (20.8)
Mean Int/ Control value	1.004/1.271	0.959/1.165	1.198/1.113	**1.265**/1.323	0.786/1.086	1.055/**1.489**	0.760/1.450
Adjacent space/mean connection	38 /3.4	35 /2.9	23 /2.6	**52 /4.7**	35 /3.2	30 /4.3	31 /2.8
High relations	10 d-pa-circulation-terrace	3 d-pa-circulation-terrace	3 d-pa-circulation-terrace	4 d-pa-circulation-terrace	2 d-pa-circulation-courtyard	**5** d-pa-circulation-courtyard	2 c-pa/ju-cir-terrace /courtyard
Route 3 (service-to-back, purple)							
No. of space	58 (17.1%)	9 (**25.7**)	8 (19.1)	11 (18.0)	**15** (16.5)	12 (20.7)	3 (5.7)
Mean Int/ Control value	**1.033/1.526**	0.873/1.107	1.055/1.115	**1.201**/1.462	1.053/1.560	1.060/1.223	0.954/**2.686**
Adjacent space/mean connection	**38 /3.8**	23 /2.6	21 /2.6	55 /5	**76 /5.1**	41 /3.4	13 /4.3
High relations	**12** d-pa-circulation-terrace	3 c-pa-cir-stairs, 1 d-pa-cir-terrace	2 d-pa-cir-terrace,c-pa-cir-stairs, c-ju-ent-stairs	3 d-pa-cir-terrace, d-pl-living area-terrace, 1 c-pa-cir-stairs	**5** d-pa-cir-terrace, 2 c-pa-cir-stairs	3 d-pa-cir-courtyard, c-pa-cir-stairs, 1 d-pa-cir-terrace	1 c-pa/ju-circulation-courtyard
Total space = 340 + 6 exterior spaces (average = **56** spaces)							

Table 6.9. Route analysis of Houses 1-6

Traditional Thai temple: **Temples 1- 6**: Route analysis							
Route 1 (front/main entrance-to-centre, red)							
	T 1-6 (2369)	T 1 (743)	T 2 (1168)	T 3 (130)	T 4 (131)	T 5 (142)	T 6 (55)
No. of space	**149** (6.3%)	28 (3.8)	**67** (5.7)	17 (13.1)	12 (9.2)	13 (9.2)	12 (**21.8**)
Mean Int/ Control value	0.717/1.765	0.757/**2.169**	0.661/2.037	0.711/1.459	**0.811**/1.820	0.655/1.491	0.707/1.614
Adjacent space/mean connection	103 (mean) /3.9	127 /**4.5**	**297** /4.4	62 /3.6	48 /4	45 /3.5	39 /3.3
High relations	19 d-pa-circulation-terrace	6 d-pa-circulation-terrace	**15** c-ju-ent-gateway, 10 d-pa-cir-terrace	2 d-pl-prayer hall-hall, 2 d-pa-cir-terrace	4 c-pa-cir-stair, 1 d-pa-cir-terrace	3 c-ju-circulation-stair	2 c-pa,d-ju-circulation-terrace
Route 2 (circumnavigation-around-centre, blue)							
No. of space	134 (5.7%)	16 (2.2)	**40** (3.4)	17 (13.1)	17 (12.9)	29 (20.4)	15 (**27.3**)
Mean Int/ Control value	**0.839/1.897**	**1.067/3.718**	0.693/1.784	0.862/1.466	0.840/1.717	0.825/1.654	0.746/1.045
Adjacent space/mean connection	104 /**4.9**	**150** /**9.4**	148 /3.7	71 /4.2	79 /4.7	127 /4.4	48 /3.5
High relations	**58** d-pa-circulation-terrace	8 d-pa-circulation-terrace	10 c-pa-cir-courtyard, 9 d-pa/ju-cir-courtyard	8 d-pa-circulation-terrace	**12** d-pa-circulation-terrace	**18** d-pa-circulation-terrace	10 d-pa-circulation-terrace
Route 3 (back/sub entrance-to-centre, purple)							
No. of space	145 (6.1%)	23 (3.1)	**65** (5.6)	13 (10)	14 (10.7)	17 (11.9)	13 (**23.6**)
Mean Int/ Control value	0.712/1.810	**0.800/2.861**	0.622/2.541	0.725/1.301	0.730/1.575	0.687/1.527	0.705/1.054
Adjacent space/mean connection	103 /3.9	123 /**5.4**	**310** /4.8	42 /3.2	47 /3.6	56 /3.3	37 /2.9
High relations	19 d-pa-circulation-terrace	4 d-pa-circulation-terrace	11/9 c-ju-ent-gateway /cir-terrace, 7 d-pa/ju-cir-terrace	2 c-pa-circulation-stair	4 c-pa-circulation-stair, 2 d-pa-cir-terrace	4 d-pa-circulation-terraces	3 d-ju -cir-terrace, 2 d-pa-cir-terrace
Total space = 2369 + 6 exterior spaces (average = **394** spaces)							

Table 6.10. Route analysis of Temples 1-6

Route analysis of the selected Thai houses

A Thai house has three basic parts: the formal-front, the living-middle and the service-back parts (Figure 6.37). Based on the movement among these three parts, three routes have been chosen to cover the whole understanding of the designs and major social activities. Route 1: front-to-back is the route taken from the front, usually the main entrance, to the back part which is usually one of sub entrances of the house. It is the most extensive and formal route used by the owners and guests who usually enter the house from the front. This route has the richest architectural experience because it accommodates the widest range of users and activities.

Route 2: front-to-service could be as extensive as (but not as formal as route 1). It normally passes through the servant quarter or kitchen and dining area. The experience along the route is usually the combination of characteristic features of the house and simple design of shared facilities. It provides the in-depth reading compared to the more architectural 'show case' character of route 1. The last coverage is the most inward experience in route 3: service-to-back which is exclusive to service sections of the house easily accessed from most places in the house and exterior space. The route is economical which does not always necessarily mean the shortest routes but it means high accessibility with inward architectural experience.

These three routes cover all the main parts of a Thai house which has a highly open-plan design with many entrances. Numerical data from routes in houses 1-6 are presented side by side in table 6.9 while the detail data of the individual routes in each house can be found in the appendix (Tables 6.9.1-6.9.18). Graphical data of routes in each house are shown in plans and axonometric drawings. The following analysis will focus on architectural effects of each route based on its actual experience and on the significant relations from earlier analyses. The discussion will also be based on two sides of space, firstly the abstract in theory and secondly the reality in design.

Theoretical and syntactic analyses of routes: the selected Thai houses

Route 1

Route 1 represents the most extensive route covering most of the house space. In houses 1, 2, 3 and 6, route 1 contains the highest integration value space in each house. Route 1 has the largest proportion of space in house 1 (34%) which means it needs more convex

spaces to convey the same information of the whole house than any other houses (Figure 6.38a&b) resulting in the lowest mean connection (2.8), the ratio of the number of spaces adjacent to the route to the number of spaces in the route. The lowest mean connection in route 1 suggests that general experience in house 1 is the most fragmented in all houses despite its moderate mean integration and control values.

In contrast to house 1, house 3 has the smallest proportion of spaces on its route 1 (18%) which means that only a few spaces are needed to cover the whole (Figure 6.39a&b). It has the highest integration value (1.265), mean connection (4.7), highest number of d-passage-circulation-terrace (4) and adjacent spaces (52). Routes 1 in houses 2 and 4 contain the lowest number of space (9) but route 1 is much more integrated in house 2 at 1.182 (Figure 6.40a&b). House 4 has the least integrated route 1 (0.731) because the front is strongly separated from the back part which is a self-contained living and service quarter (Figure 6.41a&b). As a result, route 1 in house 4 is segregated from this part and become the shallowest of the three routes in this house with the smallest proportion of space (10%).

House 5 contains the highest number of spaces in route 1 (13); it is 22% of the house's space which is the second largest proportion (22%) in routes 1 of all selected houses. The route has 3 c-passage-circulation-stairs spaces which seems to influence the low syntactic values even though the route is quite simple for a two storey house (Figure 6.42a&b). Route 1 in house 5 has the lowest control value (0.756) and the second lowest mean connection (3). In contrast to house 5, house 6 has the highest control value in all houses (1.948) because of its compactness which separates its structure into many parts. The route has to pass through many small subsystems therefore its integration value is lessened (0.864); however, it gains moderate connection at 3.4 (Figure 6.43a&b). In short, as the architectural showcase of a house, route 1 has high connection and (due to its extensive character) the lowest mean integration and control values of all three routes.

Route 2

Route 2 is often as extensive as route 1 starting from the front parts of the house and proceeds to the back where the servant quarters, kitchen and storage are. Route 2 in house 1 has the highest number and largest proportion of space in all houses. Routes 1 and 2 in houses 1, 2 and 3 are very similar; their syntactic values are almost identical in

house 2 and exactly the same in house 3 because of their extremely symmetrical design. The readings of routes 1 and 2 in experience, however, are not as similar as their numerical values show because, despite sharing many spaces, the routes approach these spaces in different directions reflecting in the inconsistency of the syntactic values. For example, the integration value of route 2 in house 2 is higher than in its route 1 even though it has many fewer adjacent spaces and the lowest mean connections. House 3 has the highest mean integration value, number of adjacent space and mean connections in route 2 of all houses due to the house's highly integrated structure as a whole.

In house 4, route 2 is very penetrative connecting the front and the deepest sub complex of the ground floor, the dining room and kitchen, which is the most diverse compared to route 2 in other houses. It has a high number of adjacent spaces and mean connections since it passes through many of the most used areas in the house. Only family members use this route since it is put away inside the family's living section reflecting in its low mean integration (0.786) and control values (1.086). The highest control value in all routes 2 (1.489) is in house 5 with the fewest number of spaces but the highest number of d-passage relation. Consequently, it has the second highest mean connections per space (4.3) with just moderate number of adjacent spaces. In house 6, route 2 has the lowest integration value but a high control value as the result of the dominant c-passage and c-junction relations. Route 2 here connects the living function, a monk's cell, to the service function, the dining hall; the route is completely internal with low connection (2.8) and the lowest integration value (0.76). In general, route 2 has the higher control value and fewer mean connections than route 1 because it is more segregated from the public domain of the houses.

Route 3

Route 3 covers the least number of spaces compared to other routes but it has the highest mean connections (3.8), integration and control values (1.033/1.526) with the strongest character of d-passage-circulation-terrace relation in all houses. Conceptually, back and service entrances are usually segregated from the rest of Thai houses but simple routes 3 as in houses 1, 2 and 6 link them together. In house 1, route 3 has the least control value (1.107) even though it is the largest proportion of space of all routes 3 in other houses (26%). It is the only route in house 1 that is dominated by c-passage relations which seem to influence the low integration value. Route 3 in house 2 has the

lowest number of adjacent spaces (23) of all routes in the house containing the fewest spaces (8) and the lowest mean connections (2.6).

Two service entrances in house 3 are located near the dining hall, space 27; one is at the front and the other at the back. Route 3 in house 3 links the front service entrance to the library at the other end. The route represents the everyday movement of the monks who, in the morning, come back from their morning walk in the community and deposit the food at the dining hall and then retreat to the study. In this example, route 3 involves with the structure of house 3 as a shared service facility and thus is not as segregated as in houses 1 and 2. Without a servant quarter, house 6 also does not have a strong character of service route but more of a common route that links the front service entrance to its back part. This results in high mean connection, integration and control values of routes 3 in houses 3 and 6. Houses 4 and 5 have similar approach but route 3 is more extensive in house 4 where back and service entrances are quite detached from each other. Route 3 in house 4 has the highest number of space (15) and adjacent spaces (76) of all routes and thus the highest mean connection (5.1). In short, route 3 is the most integrated and controlled of all routes with the least number of spaces involved.

Design analysis of routes: the selected Thai houses

In all the routes in the six houses, there are the total of eight functions: bedroom, circulation, dining area, dining room, entrance, foyer, living area and living room. There are also eight architectural elements on these routes: courtyard, doorway, gateway, hallway, room, stairs, terrace and veranda. From earlier analyses, certain functions such as circulation, entrance and living area, and architectural elements such as courtyard, doorway, room, stairs, terrace and veranda, are the main focus of the analysis. We also know that a-place, c-junction and d-passage are very certain relations while d-passage-circulation-terrace relation is very powerful and is used prolifically in the design of Thai houses in order to convey a dynamic of openness. In route 1, the relation is very dominant in houses 1, 2 and 3 but not in houses 4, 5 and it is even absent in house 6 (detailed tables of routes in each house in appendix). d-passage-circulation-terrace relation is more influential in route 2 and dominates in all houses except again in house 6. Route 3 follows the same pattern as route 2 except that d-passage-circulation-terrace is not the dominant relation in houses 1 and 6.

From the design analysis (section 6.2), other specific relations that are dominant in the selected Thai houses are entrance-stairs, living area-terrace and living area-veranda. Large proportions of these relations are related to the open space of a house in which the three routes are mostly involved with. Entrance-stairs relation is usually found at the start and end of almost all the routes in houses 1, 2 and 3 because the houses are constructed on platforms which are connected to exterior space only through stairs. In houses 4, 5 and 6, the architecture becomes more internally organised and makes full use of the ground floor so the routes formed are more focused toward the entrance-courtyard relation which is the dominant relation in contemporary Thai houses. d-place-living area-terrace relation appears in almost every route (Tables 6.9.1-6.9.18 in appendix). Living area-veranda only involves in local movement that is often in sub-complexes segregated from the main routes of a house dealing with privacy of the living units.

In all the routes, a very large proportion of open space is used as passage while the second largest proportion is related to junction and the smallest proportion is used as place. This seems to be a fundamental proportion of space that applies to the journey in most buildings but it is particularly strong in Thai houses where not only the passage or circulation-based relations but also various place- and junction-based relations are formed in its open space. In this way, the dynamism of Thai houses intertwines socio-cultural activities with spatial configuration by unifying the whole with flexibility of parts encouraging more interactions between indoor and outdoor spaces of the architecture. Apart from the strong d-passage-circulation-terrace relation, c-passage-circulation-stairs, c-junction-entrance-stairs and d-place-living area-terrace are the most common relations in the overall understanding of these selected Thai houses. c-junction-circulation-doorway is prevalent in conventional design while d-passage-circulation-courtyard relation is increasingly important in contemporary designs. Route analysis extracts and makes clear these key relations which will be further looked at together with other relations in the whole buildings in chapter seven.

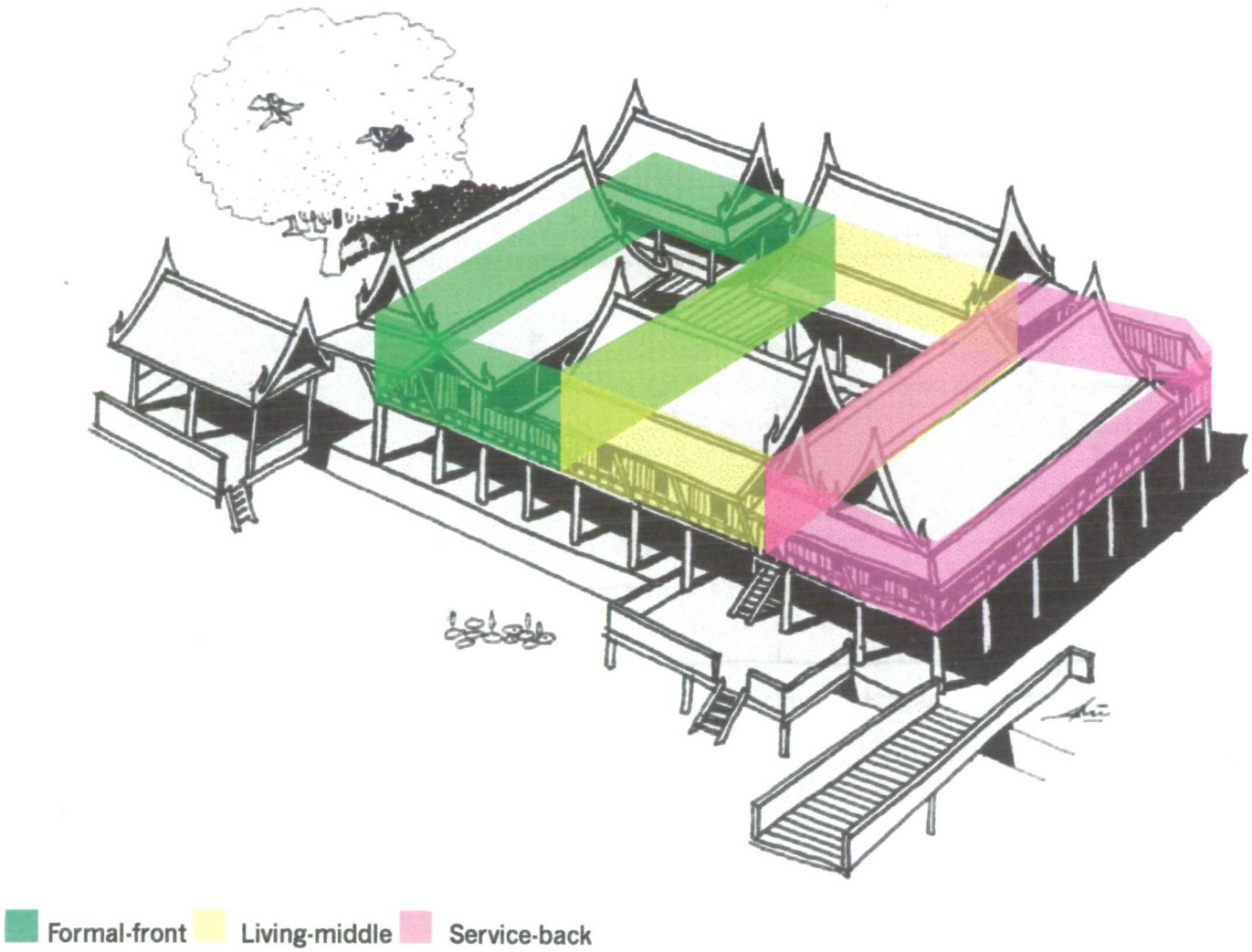


Figure 6.37 Zoning of a traditional Thai house

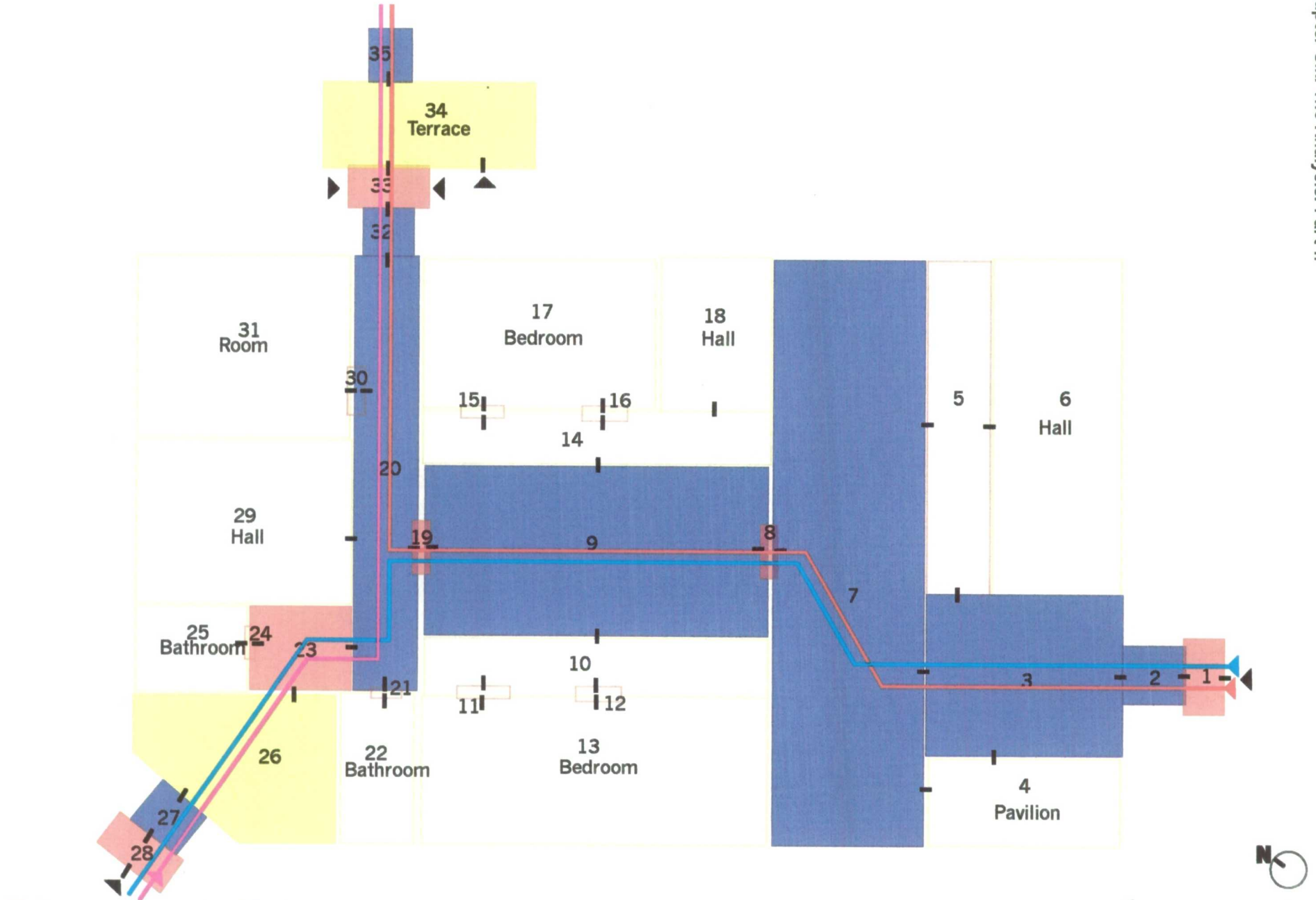
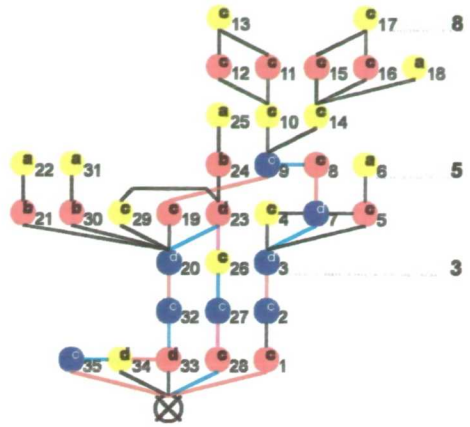
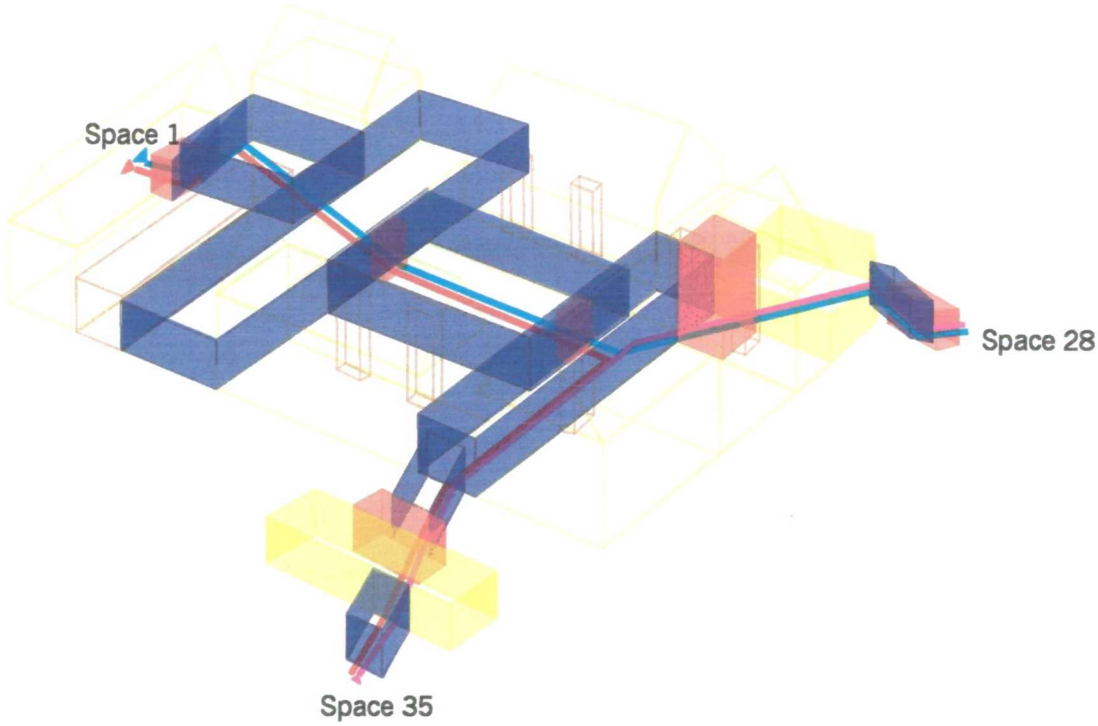


Figure 6.38a House 1 Route analysis

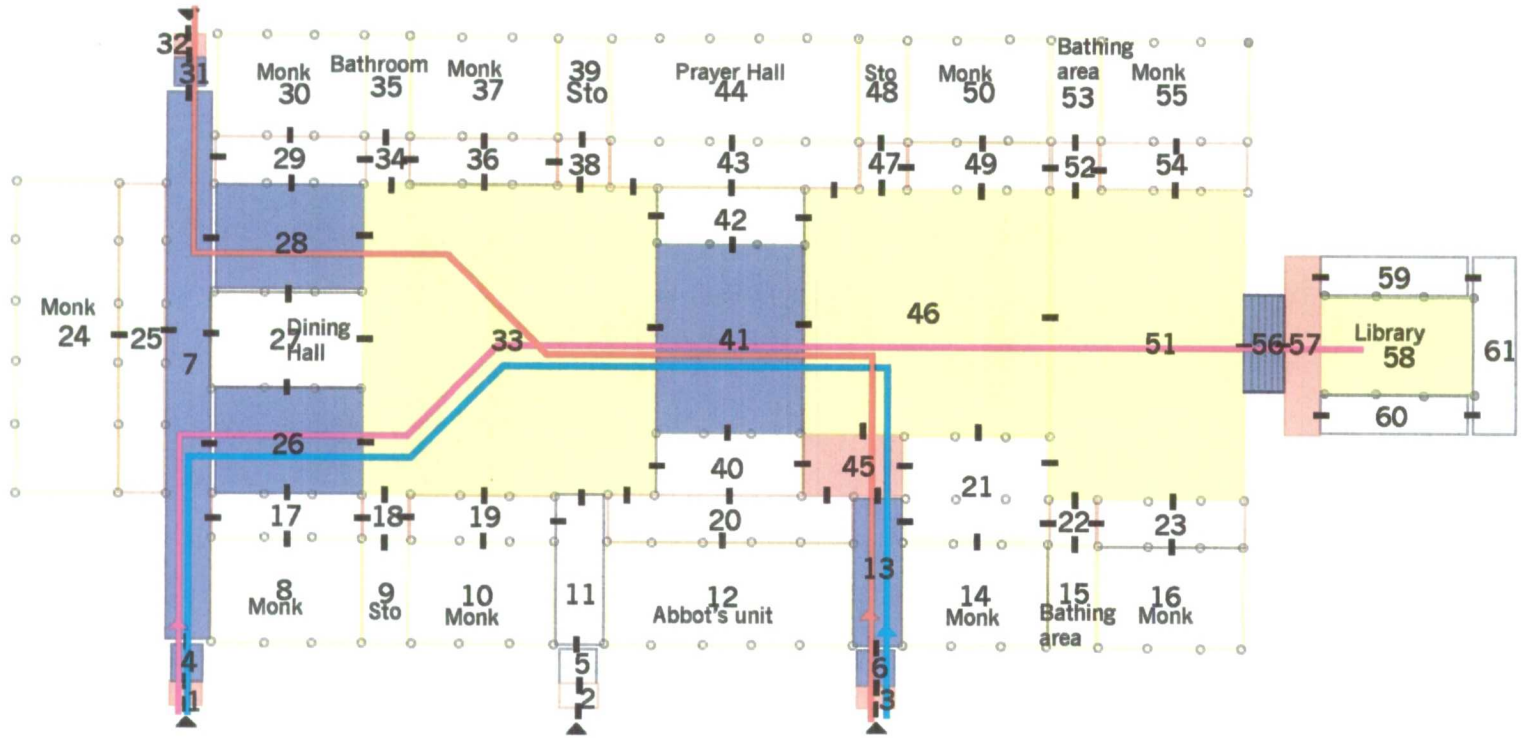




Passage Junction Place

Route 1 Route 2 Route 3

Figure 6.38b Routes in House 1



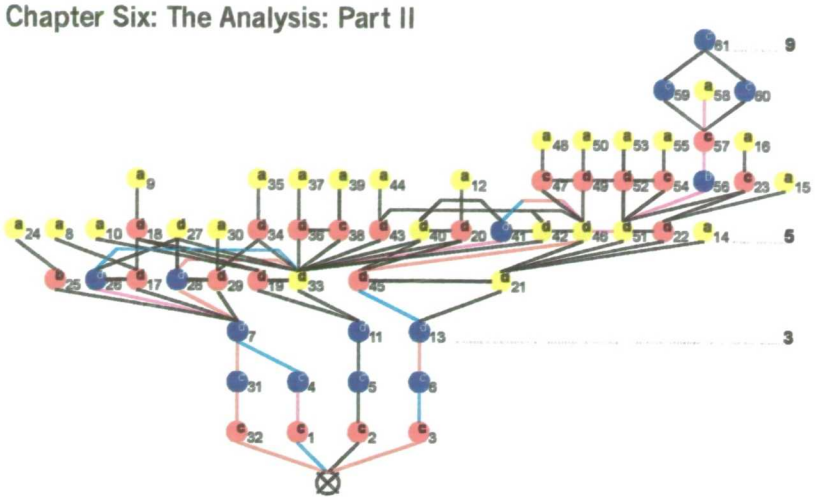
N

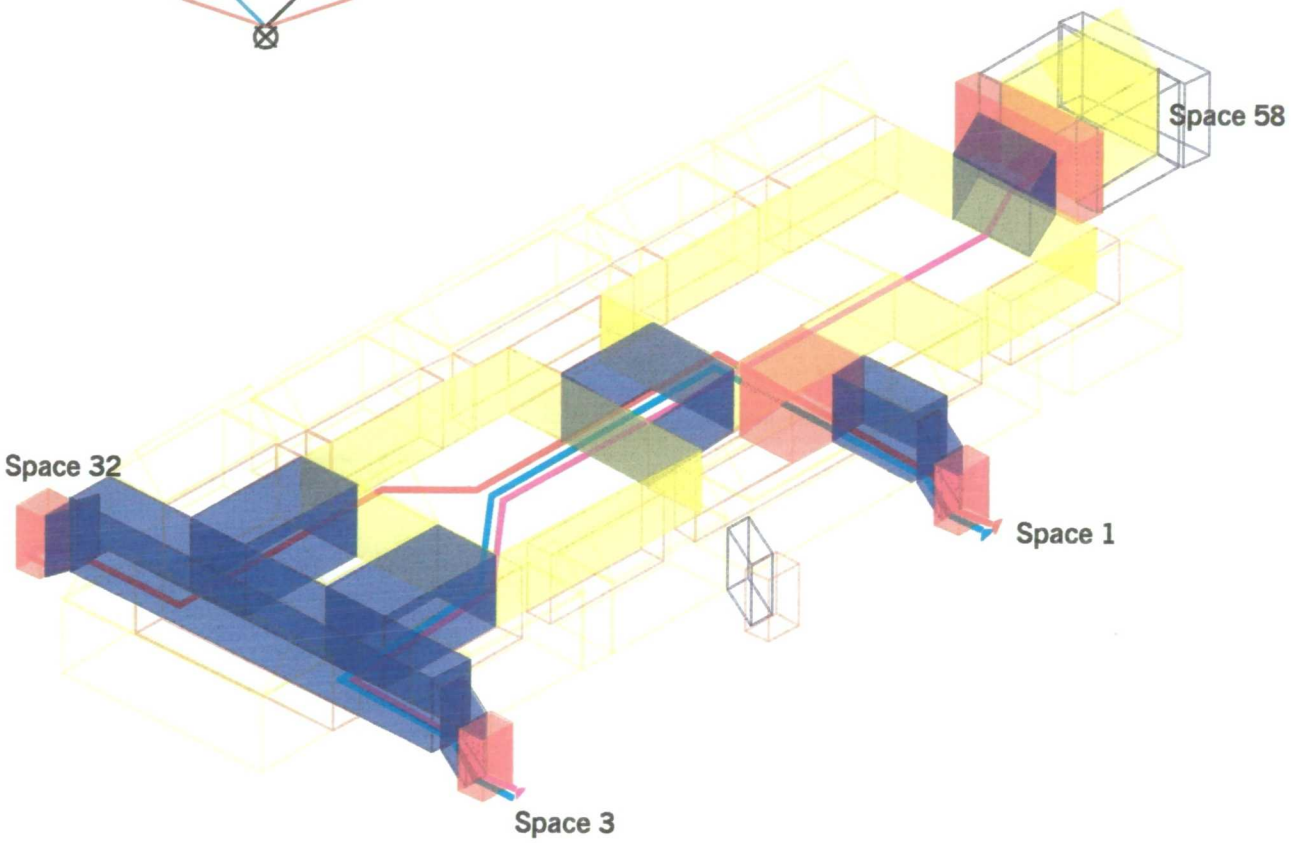
Passage Junction Place

Route 1 Route 2 Route 3

Access to ground

Figure 6.39a House 3 Route analysis





Passage Junction Place

Route 1 Route 2 Route 3

Figure 6.39b Routes in House 3

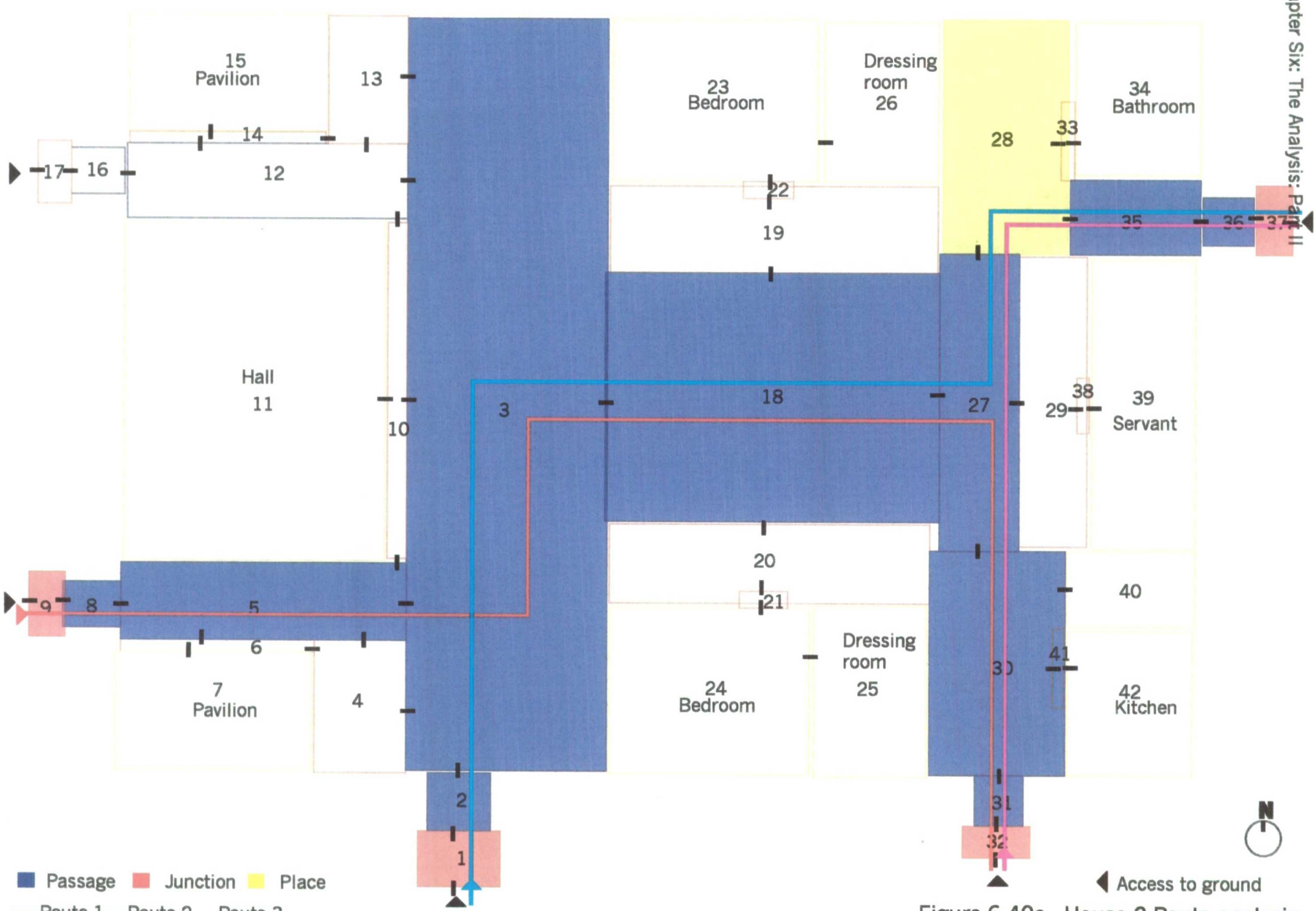
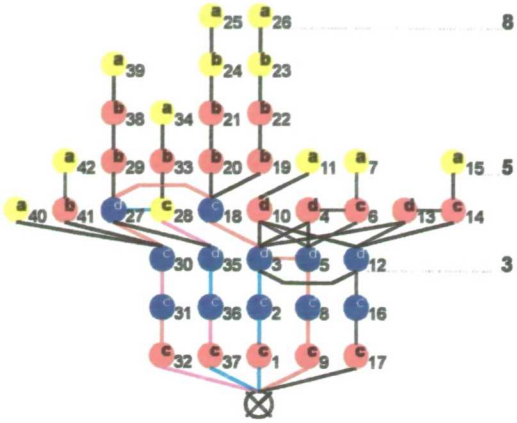
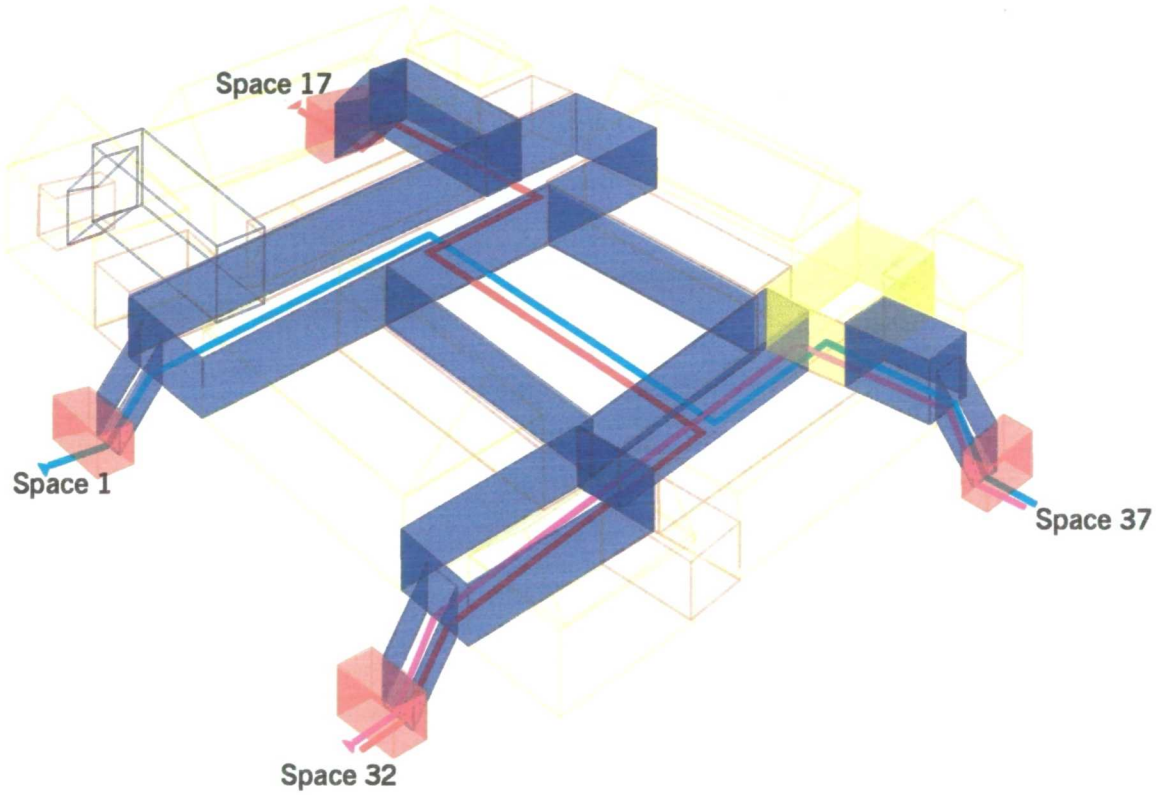


Figure 6.40a House 2 Route analysis

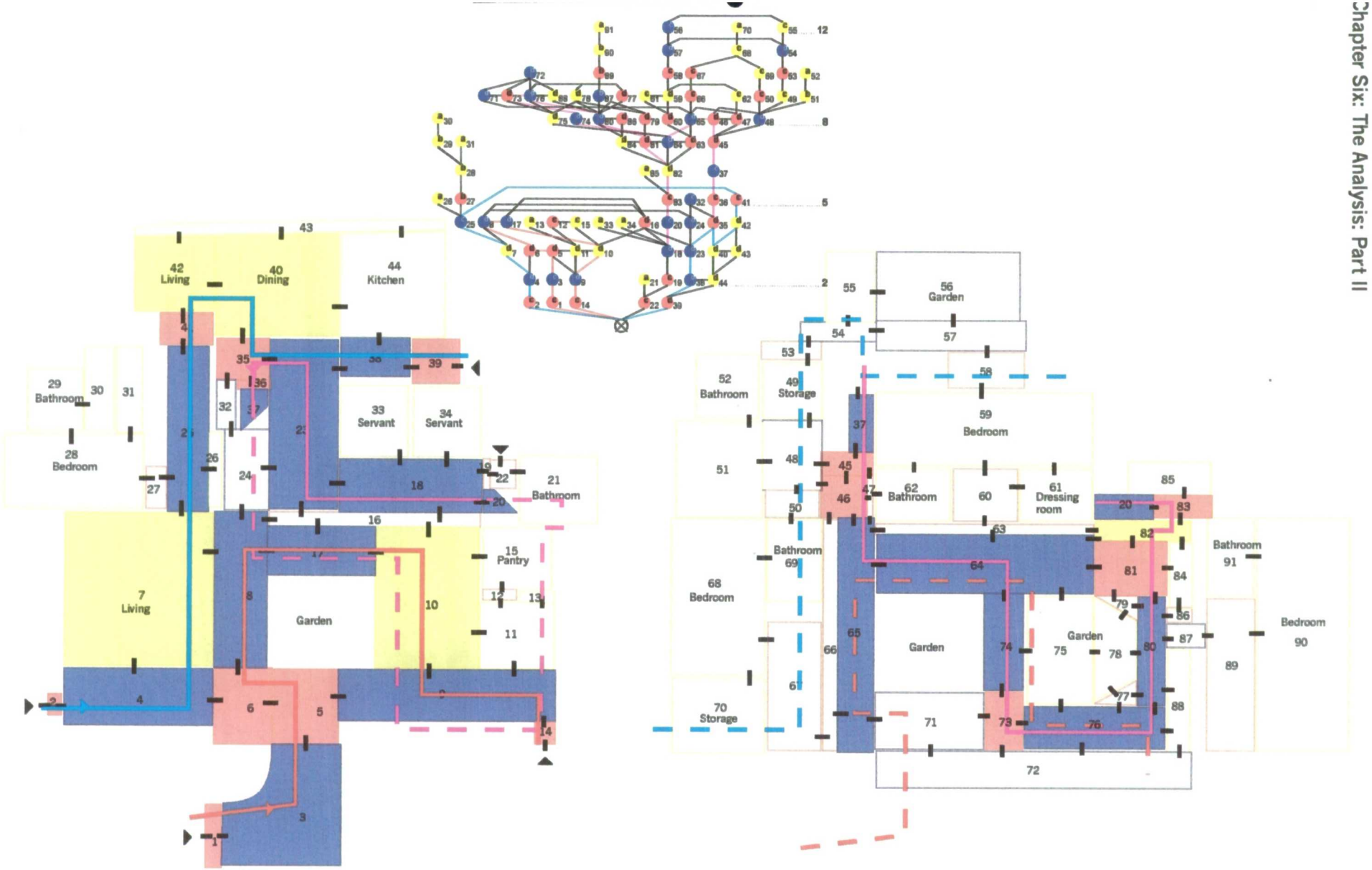




Passage Junction Place

Route 1 Route 2 Route 3

Figure 6.40b Routes in House 2



Ground floor

First floor

Passage Junction Place

Route 1 Route 2 Route 3

Access to ground

N

Figure 6.41a House 4 Route analysis

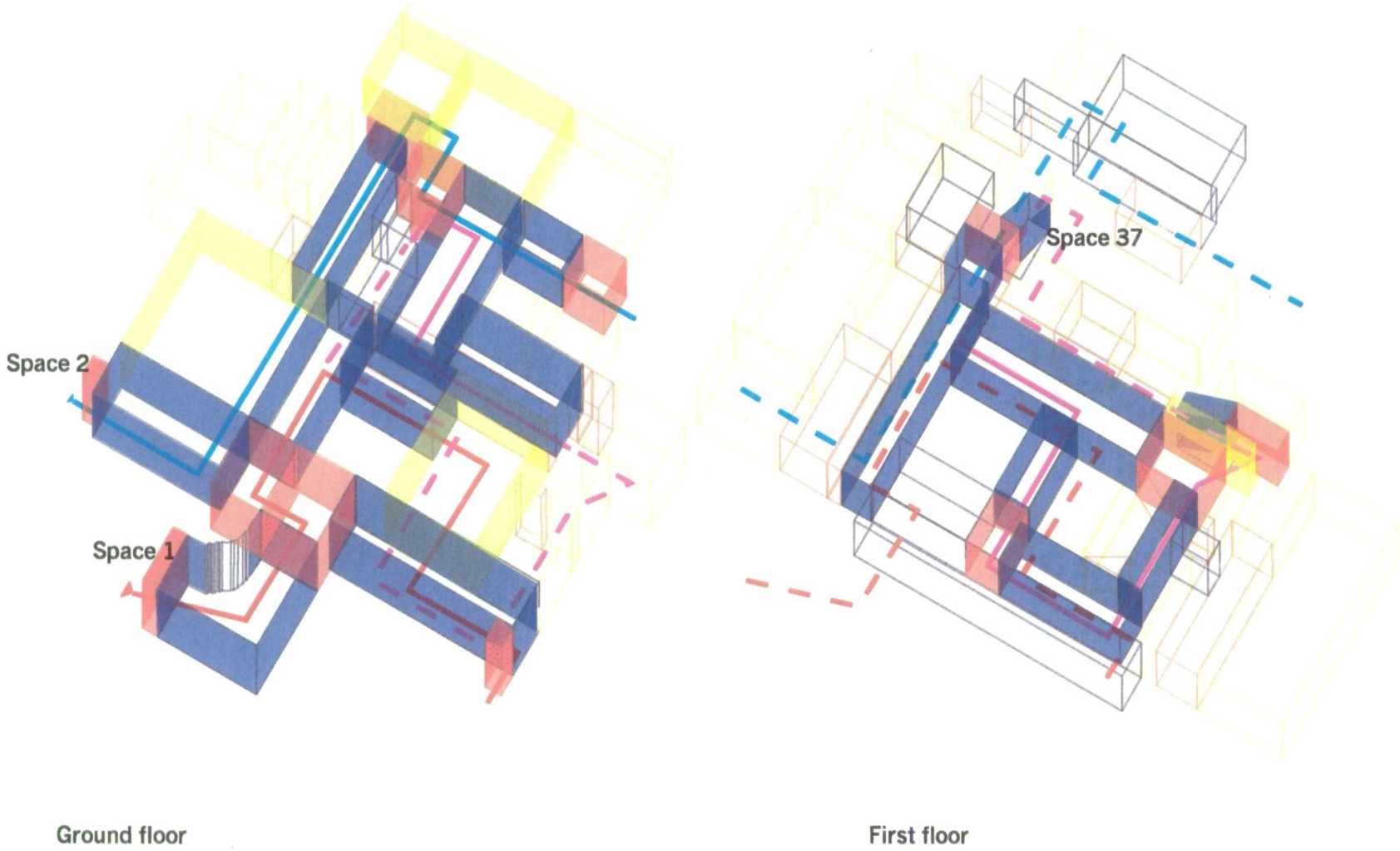
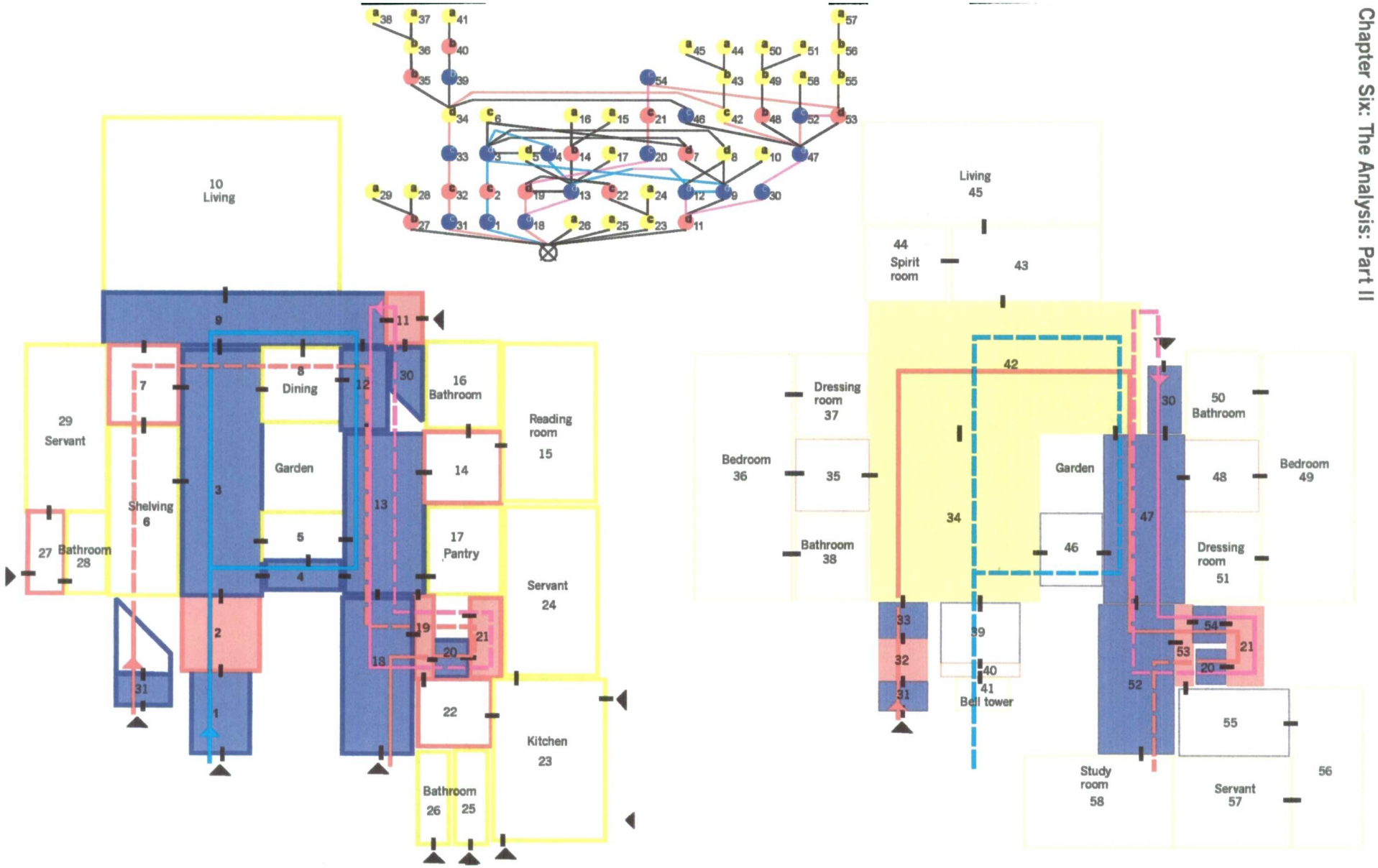


Figure 6.41b Routes in House 4



Ground floor

First floor

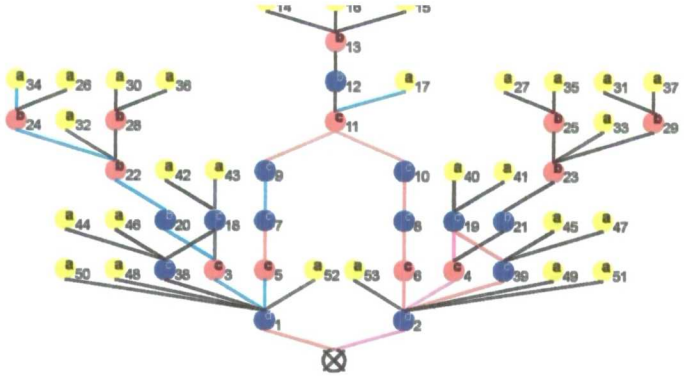
Passage Junction Place

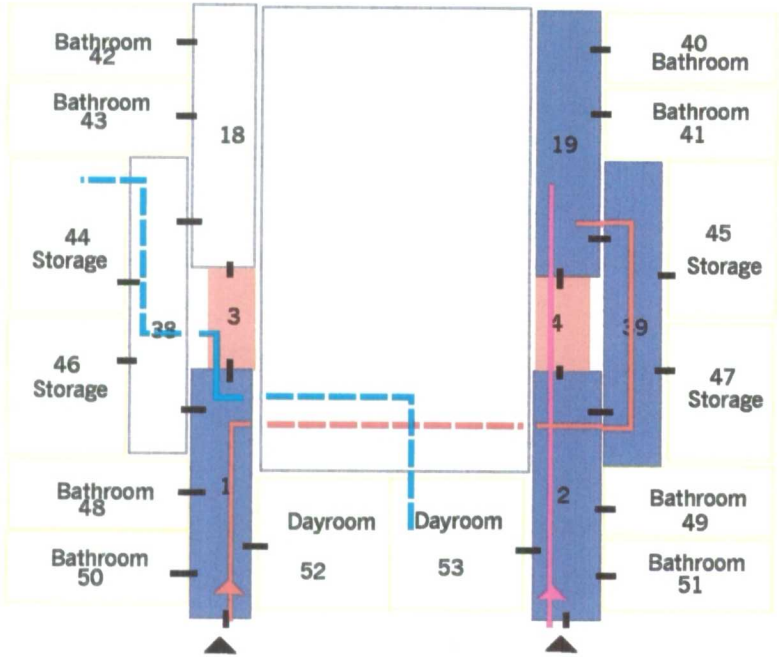
Route 1 Route 2 Route 3

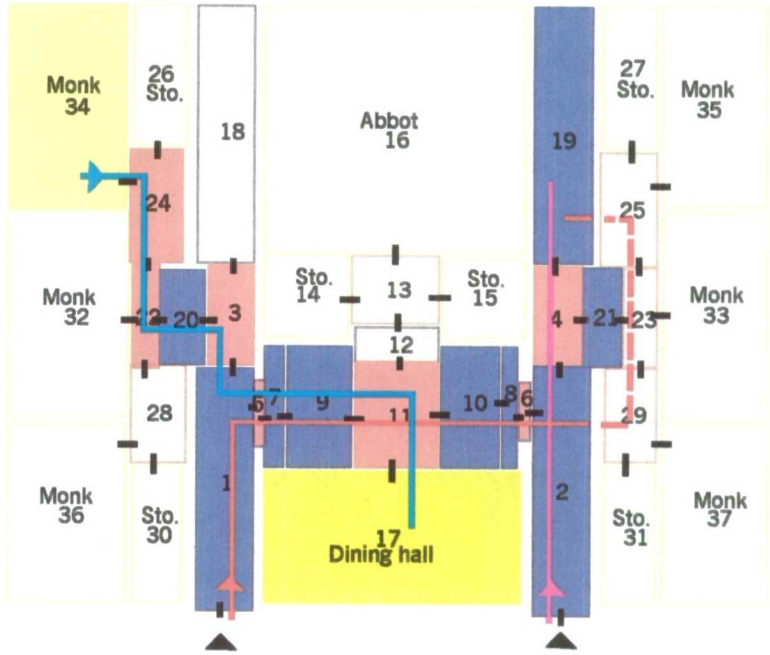
Access to ground

Figure 6.42a House 5 Route analysis

Figure 6.42b Routes in House 5







Ground floor

First floor

N

Passage Junction Place

Route 1 Route 2 Route 3

Access to ground

Figure 6.43a House 6 Route analysis

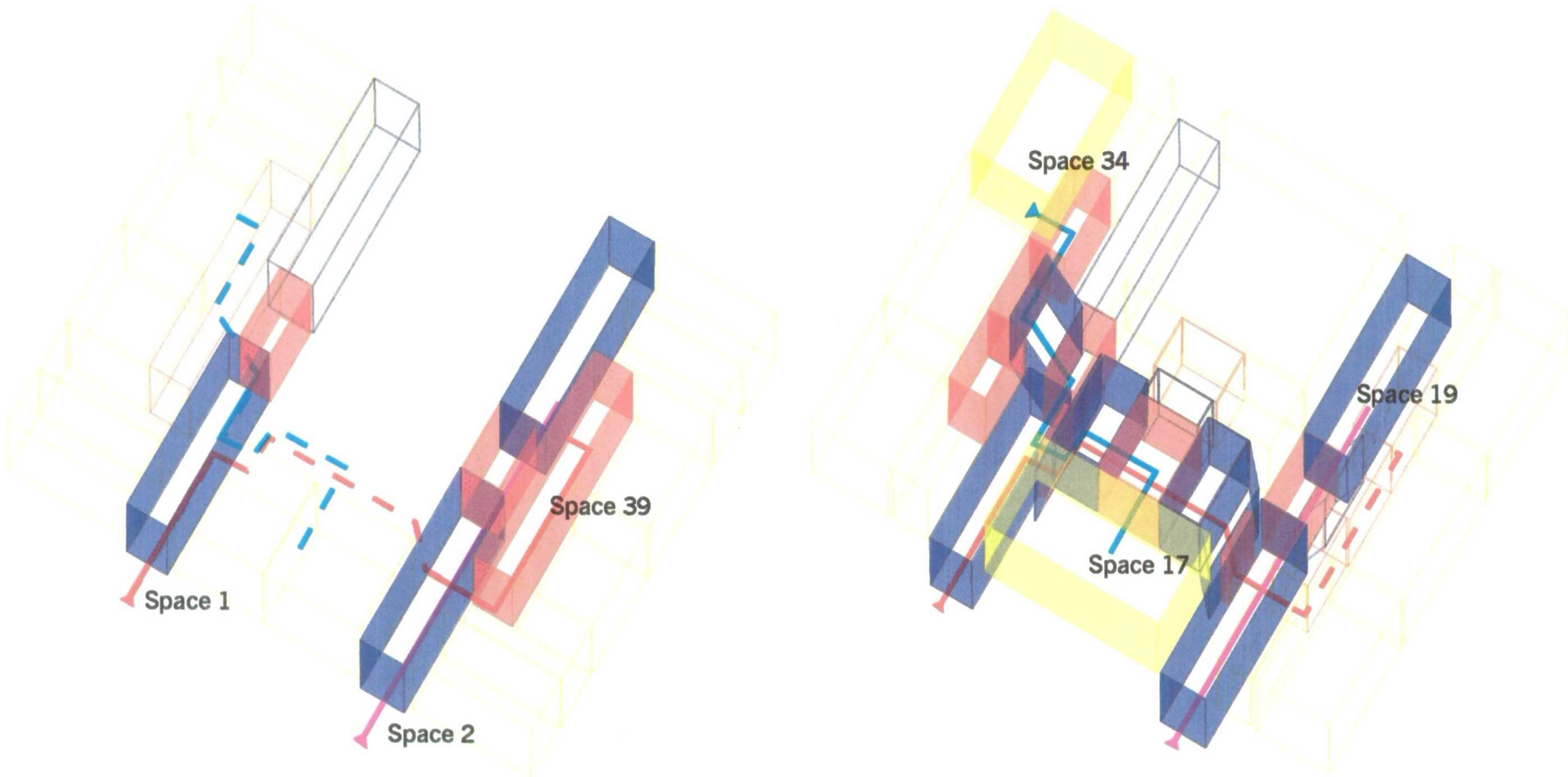


Figure 6.43b Routes in House 6

Route analysis of the selected Thai temples

The three routes have been chosen because they represent the major flow of movement of people in the selected temples. They offer the best coverage in religious and everyday activities. Unlike 'through movement' concept in the selected Thai houses, the selected routes describe temple space as 'from-to movement' because the temple space usually represents a journey from the profanity to the sacredness. Therefore, all routes have the destination at the sacred core of the temples, the *ubosot* (Figure 6.44). Route 1: main entrance-to-centre represents the movement from the formal entrance on the East side of the temples where important religious ceremonies usually start before proceeding to the centre of the temple at the *ubosot*. This route offers the most 'celebrated' architectural experience and seems to be the route that is known to the widest range of users and thus it often is the centre of the architects' design process.

Route 2: circumnavigation-around-centre represents the movement that occurs on the terrace which surrounds the *ubosot* or *wihan*. The analysis uses the clockwise circumnavigation to represent most people's experience of the journey in relation to most auspicious Buddhist activities. It also reflects the direction and sequence of space visualised in the architect's mind. This route usually involves big open spaces and the greatest distance in the journey compared to other routes. The route is very expansive in architectural experience and popular for brief visits by non-worshippers or tourists.

Route 3: back/sub entrance-to-centre has informality that deals with formal rules of religious places. People who have already known their ways around the temple such as monks therefore use this route. This suggests that this route is used by the smallest number of people and offers the flexible way to the inner core of a temple. The route is there because it was discovered by actual use over a period of time. It is also there by design in order to provide special access for monks and temple staff to enter the inner core of the temple quickly and discreetly. In conclusion, these three routes are based on people's experience as they come to pray and/or just to walk around which represent a complete picture of the temple. The important relations from earlier analyses (e.g. d-passage-circulation-terrace, c-junction-entrance-gateway and d-place-prayer hall-hall) will be emphasised alongside the key relations that emerge in these three routes (detailed tables 6.10.1-6.10.18 in appendix). As in houses, there are two parts in the discussion: theoretical and syntactic and design analyses.

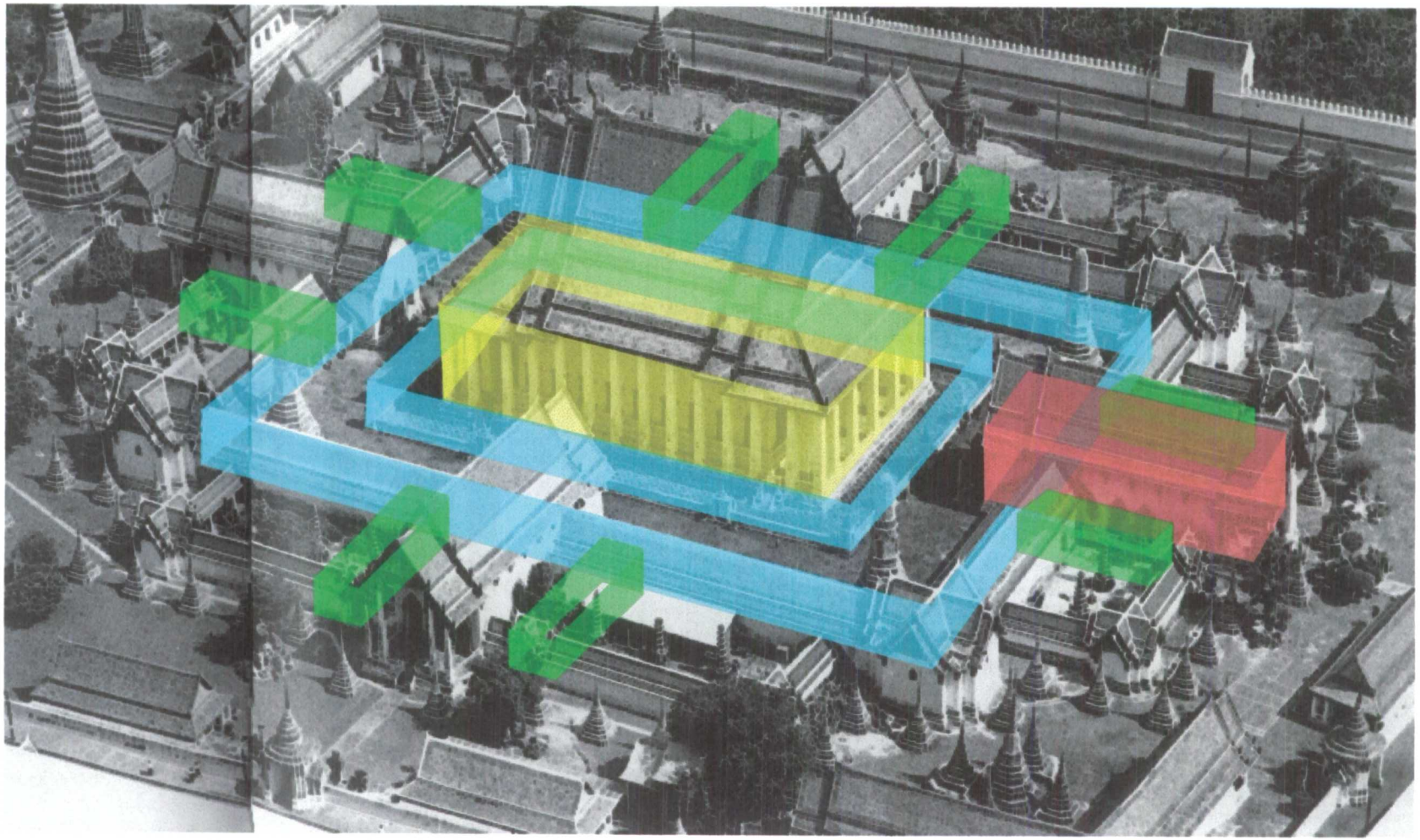


Figure 6.44 Zoning of Thai temples

Theoretical and syntactic analyses: the selected Thai temples

Route 1

Route 1 represents the formal movement from the main entrance through the main axis of a temple; it is often the direct link between exterior space and the *ubosot*. The people using the route are usually regular worshippers who only come to pray therefore, the experience portrays a temple as a religious institution. On average, the route passes through only the small portion of temples space (6%) with the lowest integration value of all three routes (0.717) and a moderate control value (1.765). The route also has a high mean connection per space (3.9) compared to routes 1 in Thai houses (3.5) due to its much higher control value. In all selected temples, route 1 contains 25 spaces on average.

Route 1 in temple 1begins at the formal entrance (space 1) on the east side of the temple through the east directional hall and then proceeds to the *ubosot* ending at space 734 in front of the Buddha image (Figure 6.45a,b&c). The route has the lowest mean integration (0.757) and control values (2.169) of all temple 1's three routes partly because it takes more spaces than any other routes to cover the journey (28 spaces). It also has the highest mean connection (4.5) which means more choices are available along the route. However, most values of route 1 in temple 1 are among the highest compared to route 1 of other temples (Table 6.10).

Temple 2 has the highest number of spaces and adjacent spaces along route 1 resulting in it having the second lowest integration among the selected temples' route 1 (0.661). Route 1 in temple 2 is the most extensive of routes 1 in all selected temples because it connects two centres of a very complicated structure. The route starts from the main entrance (space 2) to the *wihan*'s prayer hall, space 1161, (takes 27 spaces) and then proceeds to the *ubosot*'s prayer hall, space 754 (takes 40 spaces) (Figure 6.46a,b&c). However, route 1 in temple 2 requires the smallest proportion of space (6%) to cover most of religious experience in the temple and seems to be very constructive in both structural and experiential dimensions as it contains high number of d-passage-circulation-terrace space (10).

In temple 3, route 1 has the second largest proportion of space (13%) but only 3.6 connections per space. It starts at the main gateway (space 1) and passes through the most formal and decorated route of the temple and reaches the destination at the prayer

hall inside the *ubosot* (space 105). The route is well integrated at 0.711 (Figure 6.47a&b). In temples 4, 5 and 6, the routes from exterior spaces to the temple centres are very direct and short. However, routes 1 of these contemporary temples represent a larger proportion of space than routes 1 in temples 1 and 2. Route 1 has the highest integration value of the selected temples in temple 4 (0.811) but the lowest integration value (0.655) in temple 5 and the lowest mean connection (3.3) in temple 6. In these temples, route 1 is no longer emphasised as much as in the conventional temples in terms of structure of space and in real experience (Figure 6.48-6.50a&b).

In table 6.10, the proportion of space in routes 1 of the contemporary Thai temples is increasing while mean connection is decreasing. Despite the larger proportion, people are required to move no more than 13 steps to reach the *ubosot* of these contemporary temples implying that they are much less focused and formal than routes 1 in conventional temples. This shift in Thai temple designs is influenced by new interpretations in Buddhism as well as feasible conditions such as the limit of land and high competition among new temples. In short, apart from being the most sacred route in the temple, route 1 is also the best indicator of the design concept of a Thai temple, therefore the main character of a temple in both users' and designers' approach.

Route 2

Route 2 represents the movement on the terrace which works as integrator amongst all parts of a Thai temple. It starts from one of the sub entrances and circulates clockwise on the terrace around the *ubosot*. Route 2 takes this direction because it represents the real religious experience. This route is the most efficient way to understand the whole temple in the fewest number of movements. Visitors to the temple who do not come to pray in the *ubosot* usually take this route while the local people who come for religious reasons are rarely seen walking around this area. The efficiency of route 2 in describing a large area of spatial structure is shown in its lowest number of spaces in all three routes (134) with the highest integration (0.839) and control value (1.897). The route also has the highest number of adjacent spaces (104) and mean connections (4.9) as it is dominated by very high number of d-passage-circulation-terrace spaces (19).

In temple 1, route 2 starts from one of the sub-entrances (e.g. space 12) where one walks through the small passage into the outer cloister that surrounds a courtyard. From here,

another connection through the wall of the inner cloister leads to the open view of the lower terrace (space 561) that surrounds the *ubosot*. At this point, the gateway to the inner terrace is clearly visible, one can either walk in through the gateway or walk around on the lower terrace. Once on the lower terrace of a Thai temple, the complete picture of the *ubosot* can be seen as the terrace is usually wide enough. Following this route, one can walk around and get out from the complex through entrances along the lower terrace.

The basic concept of route 2 is to integrate many parts of the temple together. In temple 2, route 2 works in a very large scale to encompass two centres: the *wihan* and *ubosot* resulting in its lowest integration (0.693) with the second highest control values (1.784). It runs through the temple's extensive courtyards that link the terrace of one centre to another. Routes 2 in all other temples also have high connections and very high number of adjacent spaces (the average of 4.9 and 150, respectively). In temple 5, route 2 integrates the new *chedi* complex at the back resulting in its high number of adjacent spaces (127) and mean connections (4.4). Route 2 in temple 6 has the lowest integration value (0.746) but contains the largest proportion of space in all three routes (27%).

Route 3

Route 3 involves more spaces than route 2 (6% of all temple spaces). Route 3 represents a less formal experience of religious activities than route 1 since it starts from one of the sub entrances and proceeds in the various directions towards the centre. Monks, staff and regular worshippers often use this route. Route 3 is quite subtle in real experience because its concept does not base on its structural significance in the building but on the personal knowledge of the place through regular use. This fact reflects in its lowest integration (0.712) and moderate control values (1.810). In this way, the route is usually more segregated than other routes and thus contains the least number of adjacent spaces (123). The route becomes a routine and informal way of reaching the centre.

In temple 1, route 3 leads one to the upper terrace very quickly if one walks right through the gateway when arriving on the lower terrace (space 583). It then leads onto the upper terrace and enters the *ubosot* from the back stairs (space 739) through a doorway that leads to space 735 behind the Buddha image. Due to the large number of people using the front entrance in route 1, monks tend to use this more secluded entrance to get into the *ubosot*. They will then walk along the hallway (space 718) that leads to the front of the

ubosot and the monk platform next to prayer hall (space 734). Taking route 3 to the prayer hall is faster than route 1 with the similar variations in architectural elements along the way. In temple 1, route 3 involves fewer spaces than route 1but has the highest control value (2.861) and mean connections per space (5.4) in routes 3 of all temples.

In temple 2, route 3 contains the highest number of space (65) which represents only 6% of the temple spaces. It connects the *ubosot* and the *wihan* by starting from the back of temple 2 where the monk quarters are. The route reaches the *ubosot* first making it very convenient for monks to conduct daily religious activities while the *wihan*, occasionally used in special ceremonies, is at the location closer to the public. In this way, route 3 here is structurally and experientially the opposite of the public and formal route 1. However, routes 3 and 1 in temple 3 are quite similar because the design of the temple is symmetrical throughout from the entrance to the interior of the *ubosot* resulting in syntactic properties of the two routes are closely comparable. However, route 3 in temple 3 has no dominant relation that characterises the route (Table 6.10.3). Because of its subtle presence, the route is moderately integrated (0.725) to the whole and has low control value (1.301) with the lowest mean connection (3.2) of all routes in all temples.

Monks and temple staff are the main users of route 3 in temple 4. The entrance to the *ubosot* on this route is almost hidden away at the back of the *ubosot* however it has the highest mean connection of all routes 3 in the selected contemporary Thai temples (3.6) resulting in its high control value (1.575). Temples 5 and 6 both have side entrances but in temple 5 route 3 is less exclusive for monks and staff. Route 3 in temple 6 needs only 13 steps to move from the exterior into the *ubosot* with the lowest number of adjacent spaces (37) and mean connections (2.9). In general, routes 3 in temples 4, 5 and 6 contain larger proportions of spaces than temples 1, 2 and 3. In conclusion, route 3 represents the design strategy that makes the whole structure of temples and *ubosot* spaces more accessible and easily circulated by simple movement.

Design analysis: the selected Thai temples

The most common relation in the design of Thai temples is d-passage-circulation-terrace which expresses similar dynamism to Thai houses; it dominates almost all routes in both the experience and structure of movement in major activities. From earlier analyses, the circulation-based relations are dominant with a large proportion in the selected buildings

and the three routes (Tables 6.10.1-6.10.18). Relations such as circulation-stair and ciculation-doorway also present the hierarchy of sacredness enforced by a change of level which is similar to the design strategy used in Thai houses to gain privacy. Entrance-gateway and prayer hall-hall relations have very strong impact especially when one moves along the formal routes like route 1 in conventional temples however the impact of entrance-gateway is lessened in contemporary temples.

In the selected routes, entrance-gateway often forms c-junction-entrance-gateway relation while prayer hall-hall usually forms d-place-prayer hall-hall relation. Structurally, c-junction-entrance-gateway is more crucial to the temples on a larger scale than d-place-prayer hall-hall relation. This reflects in the higher number of space and integration of c-junction-entrance-gateway relation. d-place-prayer hall-hall relation is always the destination for the worshippers and the centre of attention for the designers since it defines everything about a temple. Statistically, this relation has been almost invisible among other relations but it becomes highly visible in route analysis and even dominates the experience of route 1 in temple 3 (Table 6.10). Route analysis also shows that a-junction-orientation-window relation is not a part of any route but it is the part of space inside the *ubosot*. This relation conveys symbolic reference rather than physical engagement in using a Thai temple. d-place-prayer space-terrace is a new relation in Thai temples and is often created by the need of more worship space in actual situations. This relation has become more a destination rather than simply being accommodated into the major routes in both conventional and contemporary temples.

In conclusion, there are relations that are important in both global and local scales of Thai temple designs. In the selected Thai temples, d-passage-circulation-terrace, c-junction-entrance-gateway and d-place-prayer hall-hall seem to be the key relations which other relations are designed around. These relations define what a temple is about for its users and designers through the way it is conceived in relation to the known physical elements in environment and bodily movement in social activities. Other design relations that could differentiate conventional and contemporary Thai temples are also made clearer in the route analysis such as c-passage-circulation-cloister and courtyard are found in conventional design while d-place-foyer-hall are present in contemporary designs with a small impact. The importance of d-passage-circulation-terrace is further enhanced in contemporary designs.

Route analysis makes it possible to point out very important relations that actually play significant roles in the most significant parts of the selected buildings. Therefore, it aims to emphasise the relations that are highly visible from real actions in both global and local concepts of the selected architectural space. However, the discussion does not aim at establishing the logic of architectural design since this cannot be done in parts but must be done as a whole. In the next chapter, the design strategies are discussed in the presence of all relations that are used in the selected Thai houses and temples

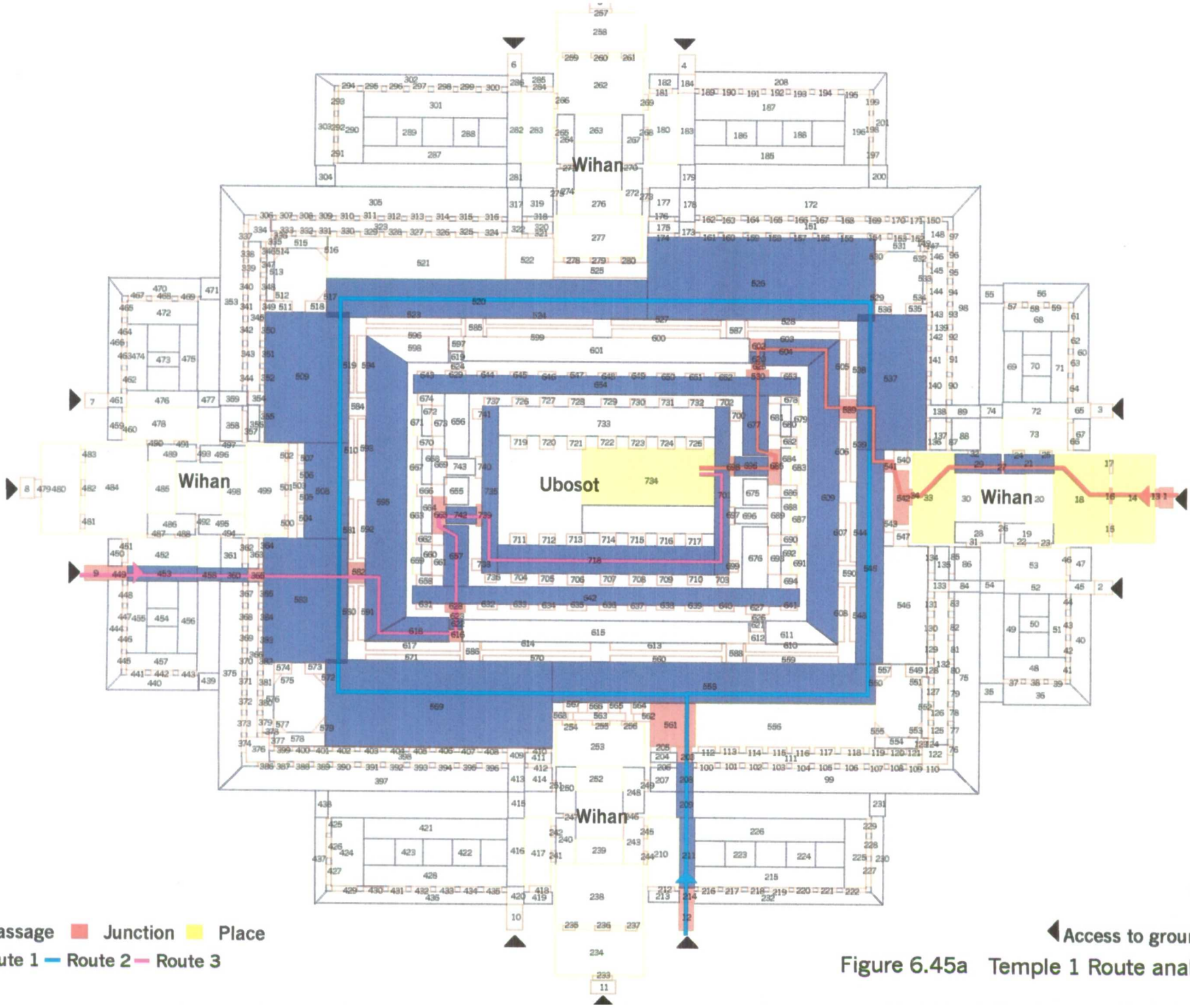


Figure 6.45a Temple 1 Route analysis

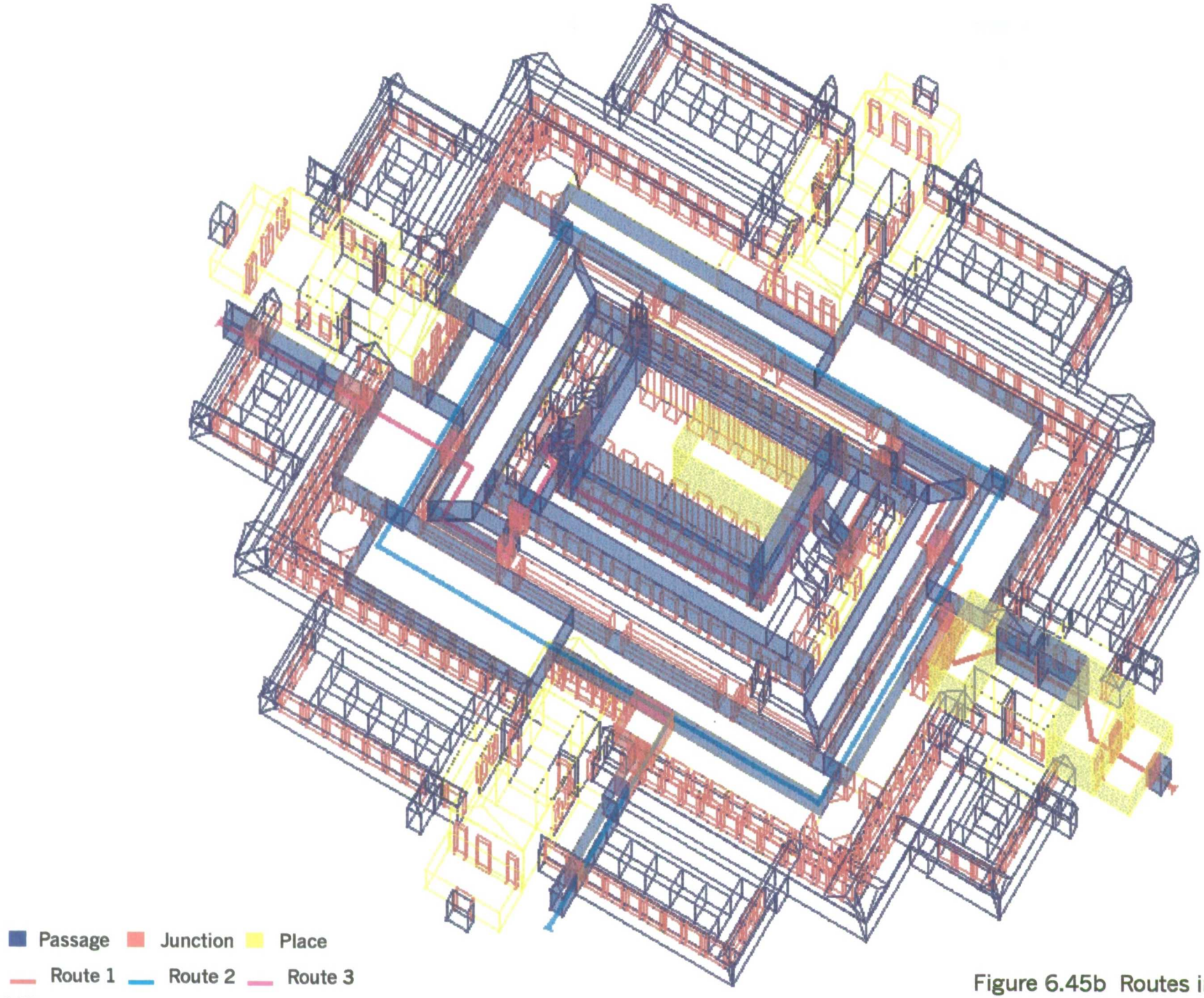
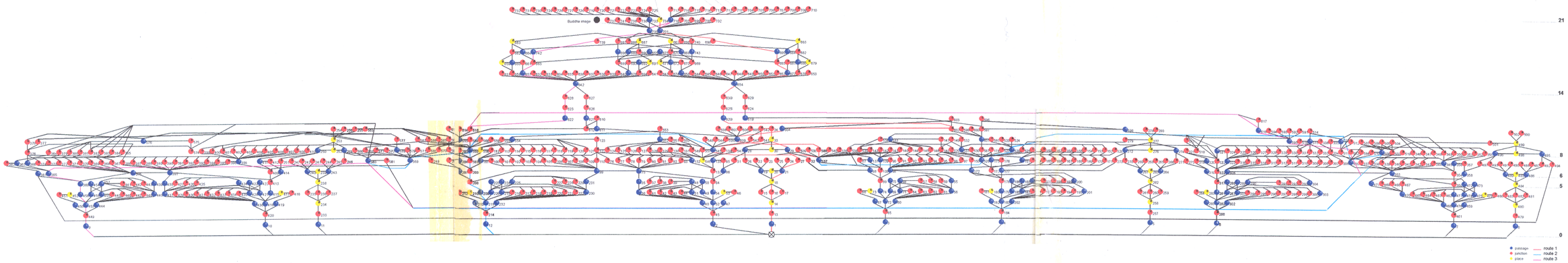


Figure 6.45b Routes in Temple 1



Passage Junction Place

Route 1 Route 2 Route 3

Figure 6.45c Temple 1's J-graph with routes
Total space = 743 + 1 ext and 1126 links, Space-Link Ratio = 1.515

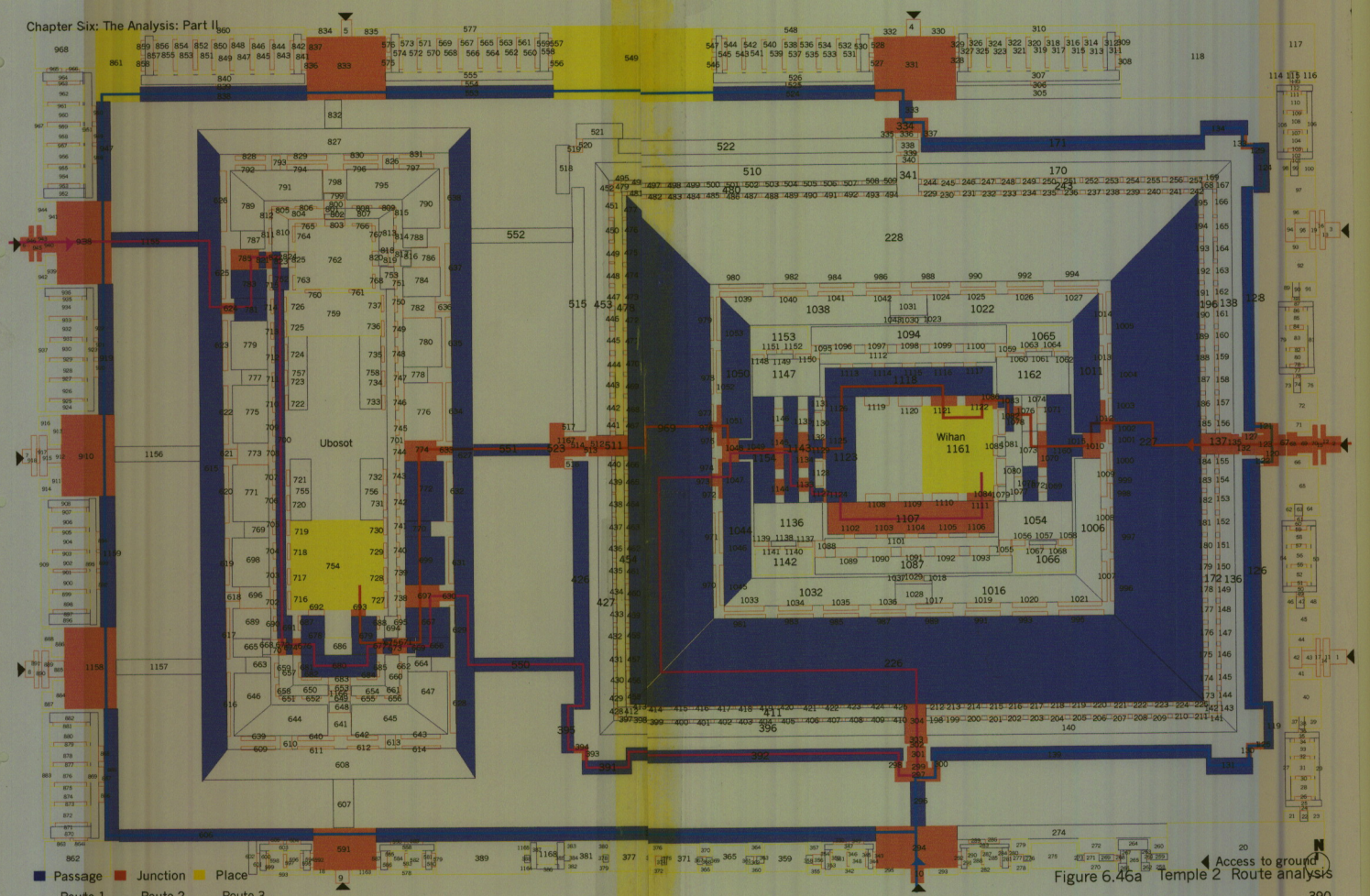


Figure 6.46a Temple 2 Route analysis

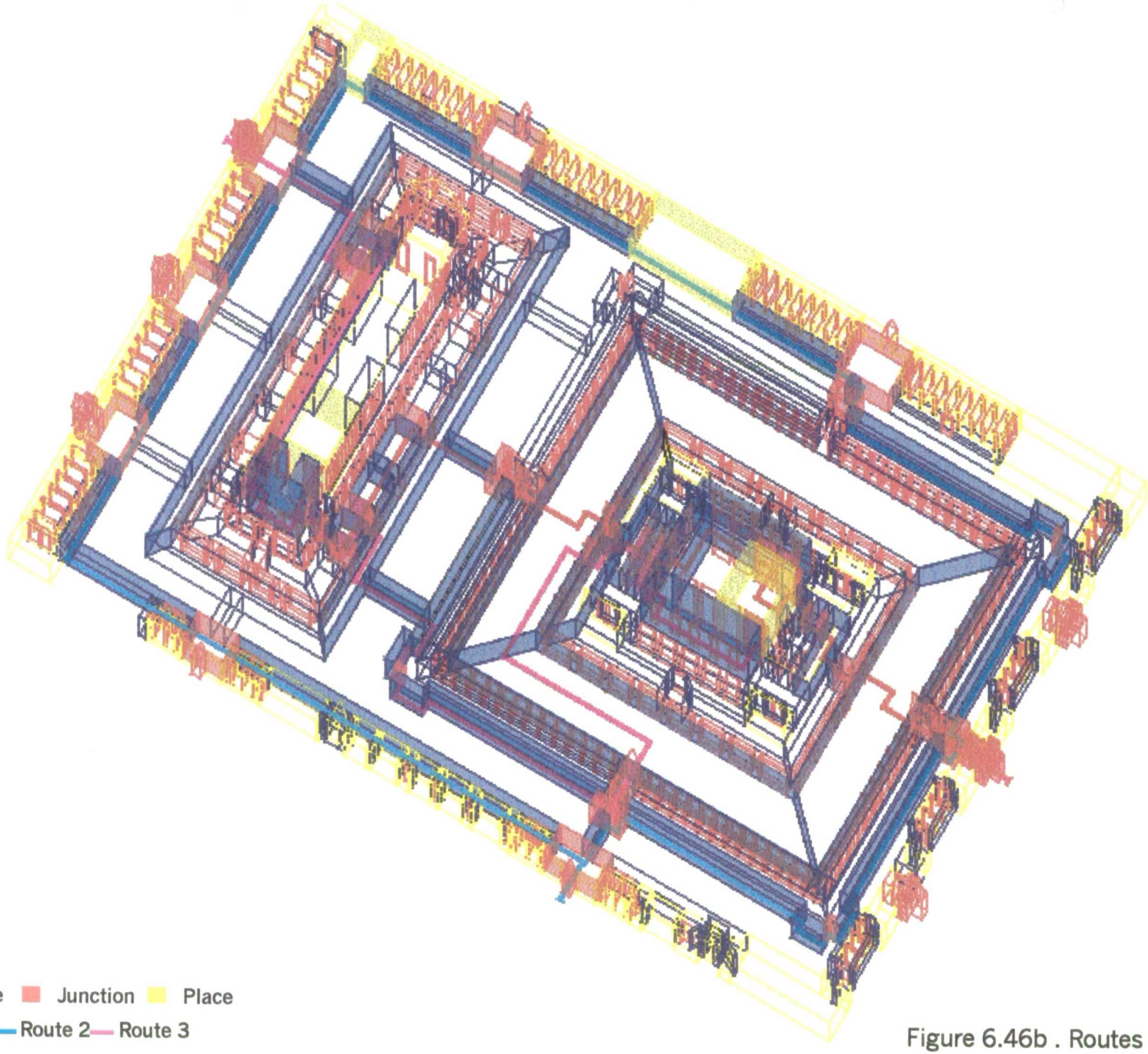
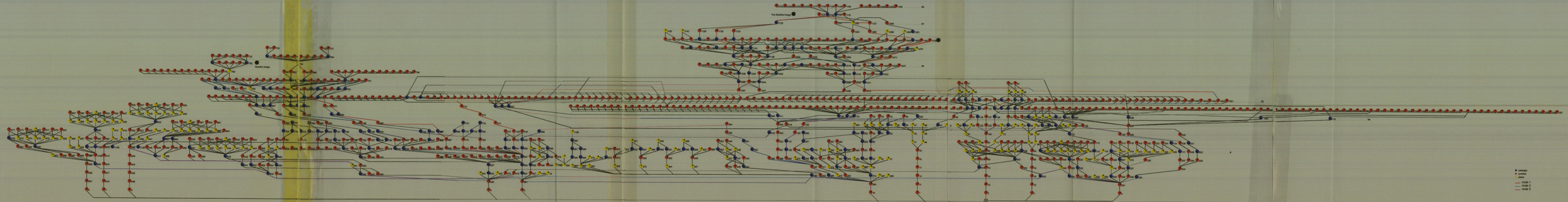


Figure 6.46b . Routes in Temple 2



Passage Junction Place
Route 1 Route 2 Route 3

Figure 6.46c Temple 2's J-graph and routes
Total Space = 1168 + 1 ext and 1706 links, Space-Link Ratio = 1.460

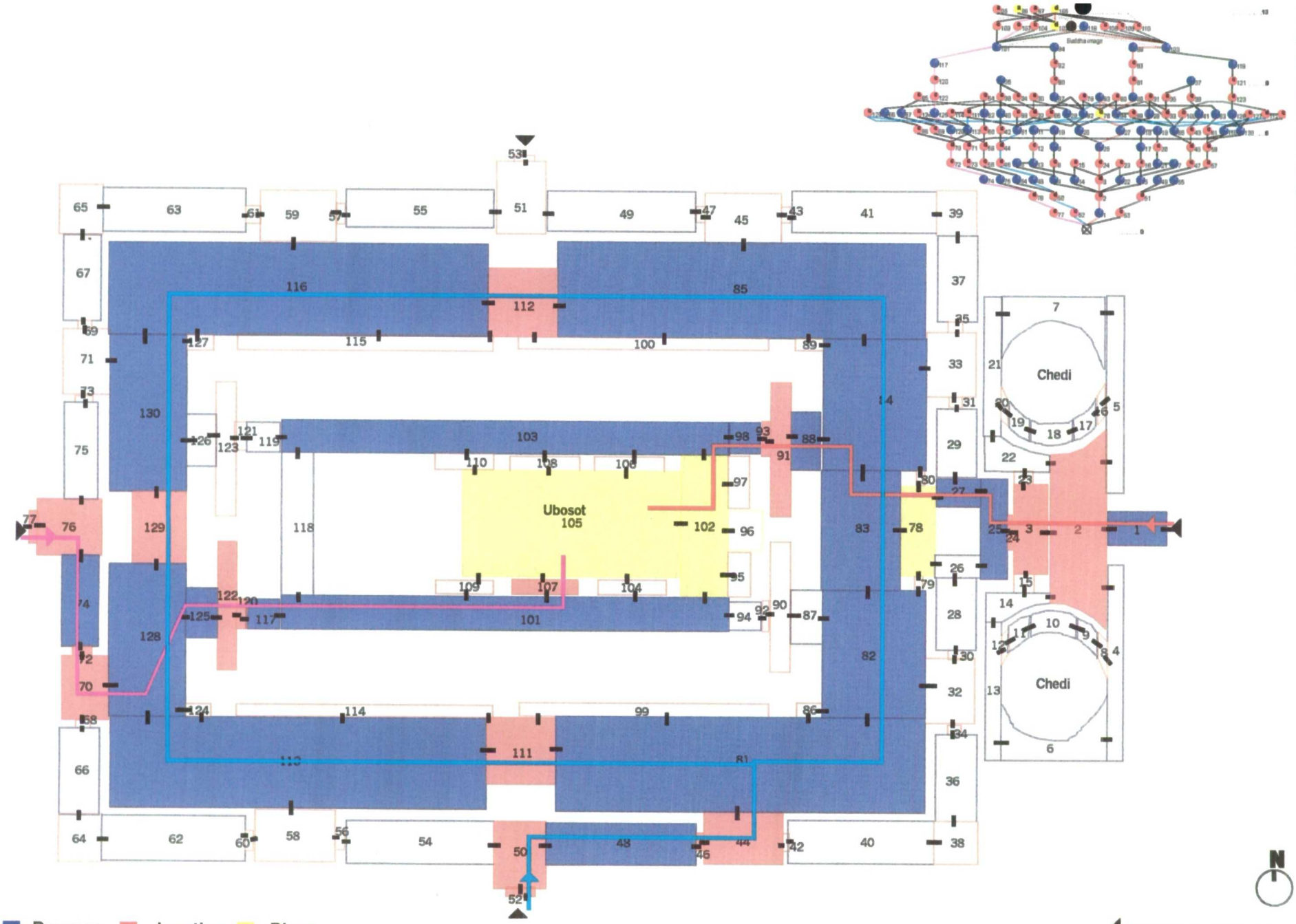


Figure 6.47a Temple 3 Route analysis

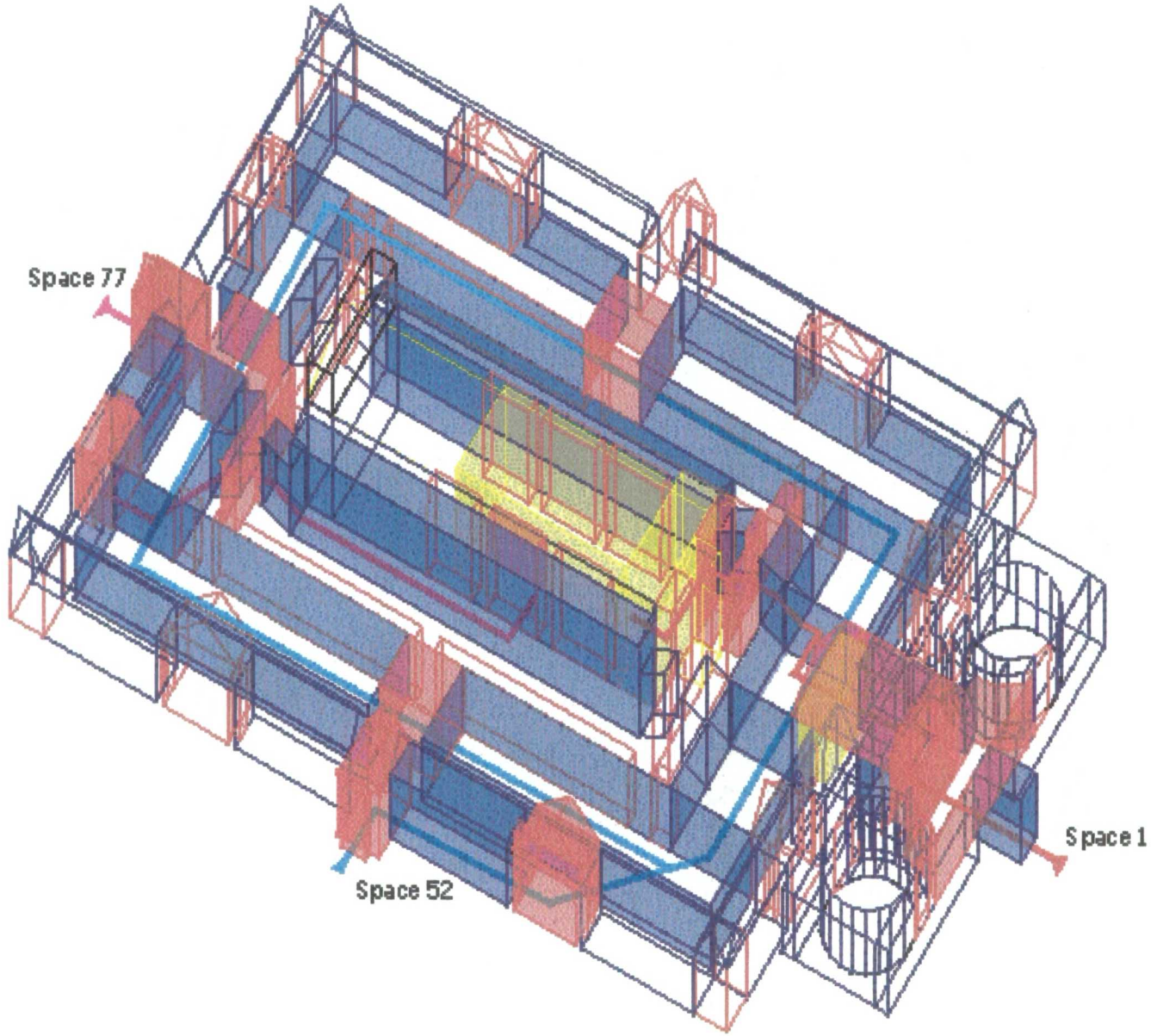


Figure 6.47b. Routes in Temple 3

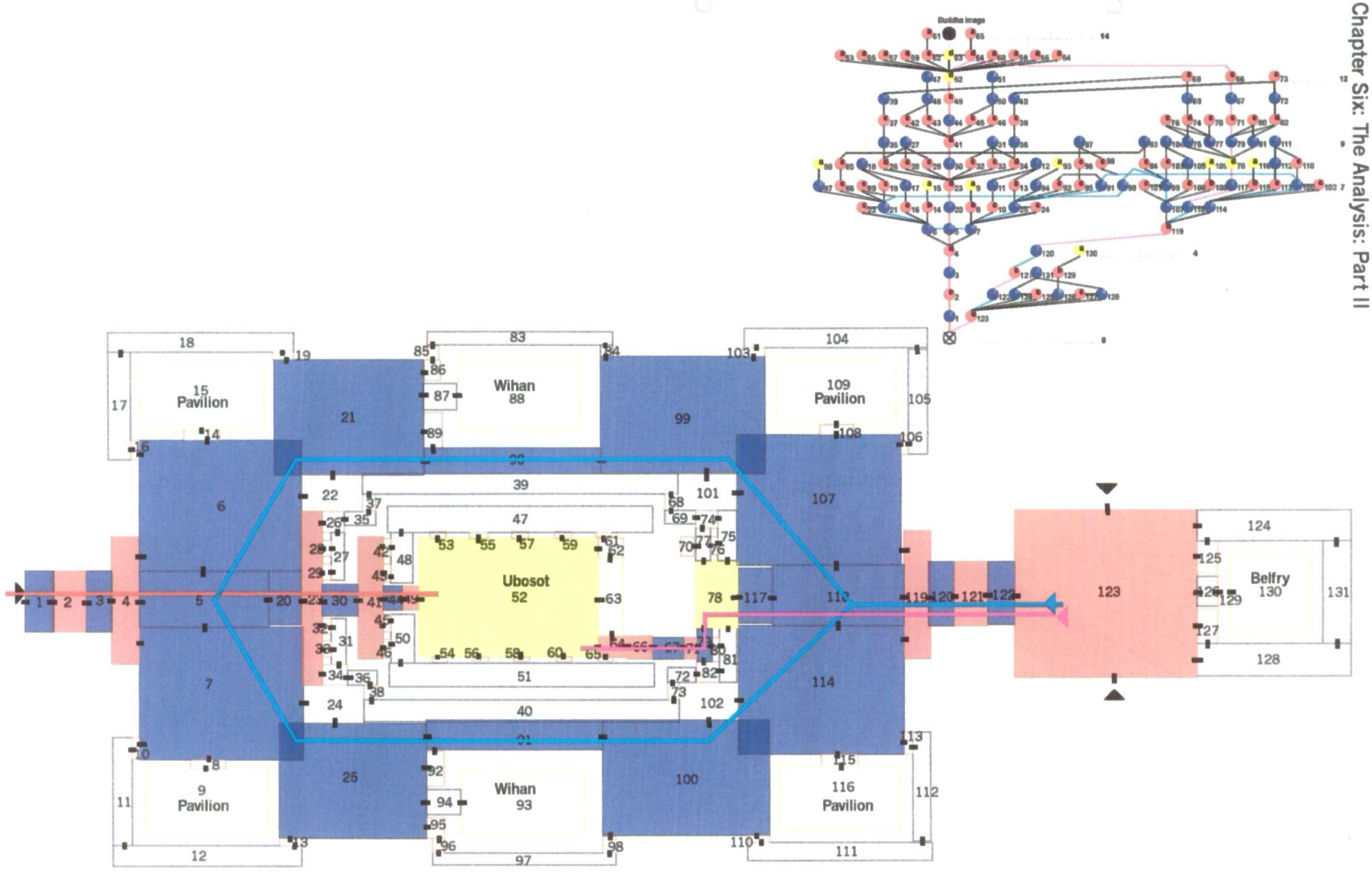


Figure 6.48a Temple 4 Route analysis

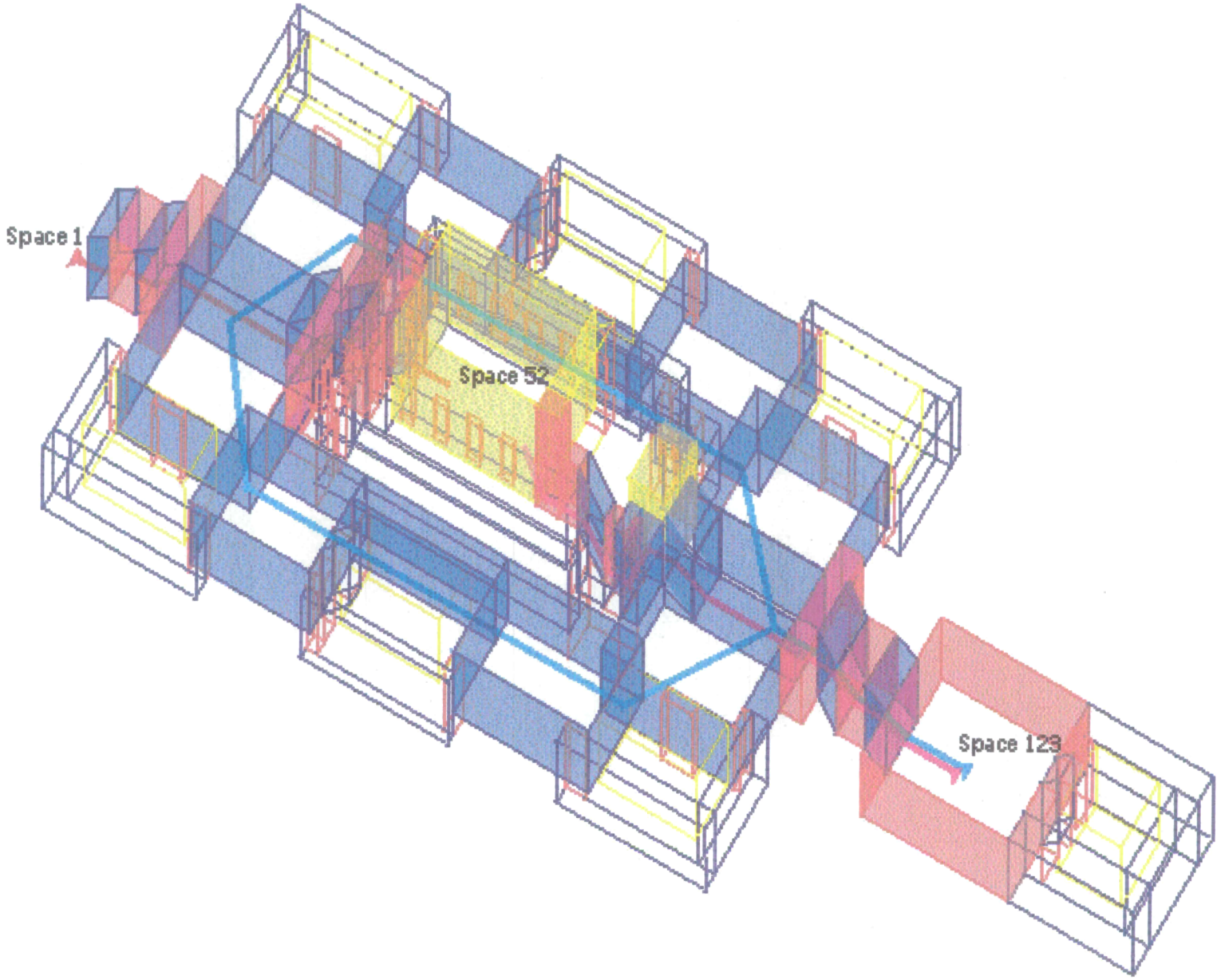
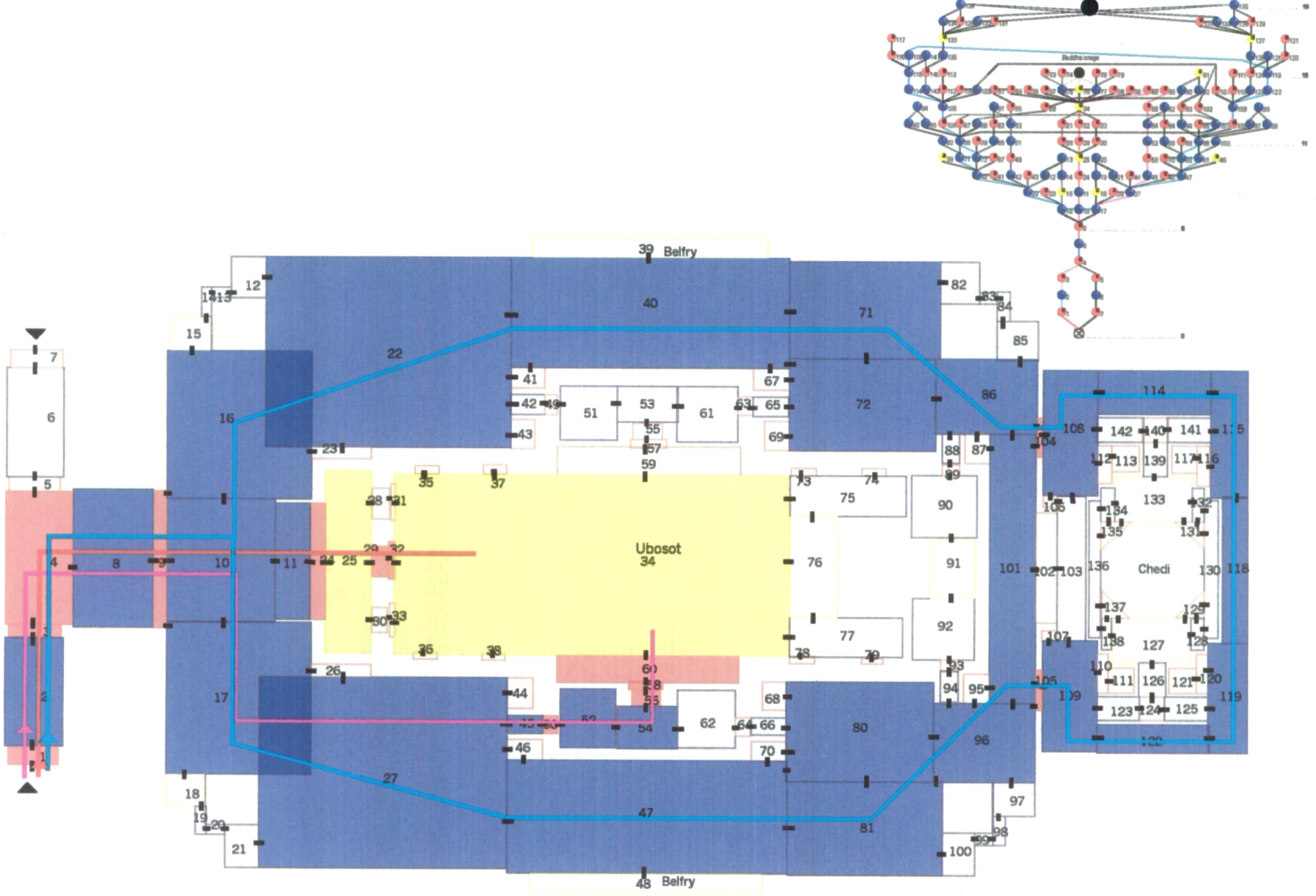


Figure 6.48b Routes in Temple 4



Passage Junction Place

Route 1 Route 2 Route 3

N

Access to ground

Figure 6.49a Temple 5 Route analysis

Figure 6.49b Routes in Temple 6

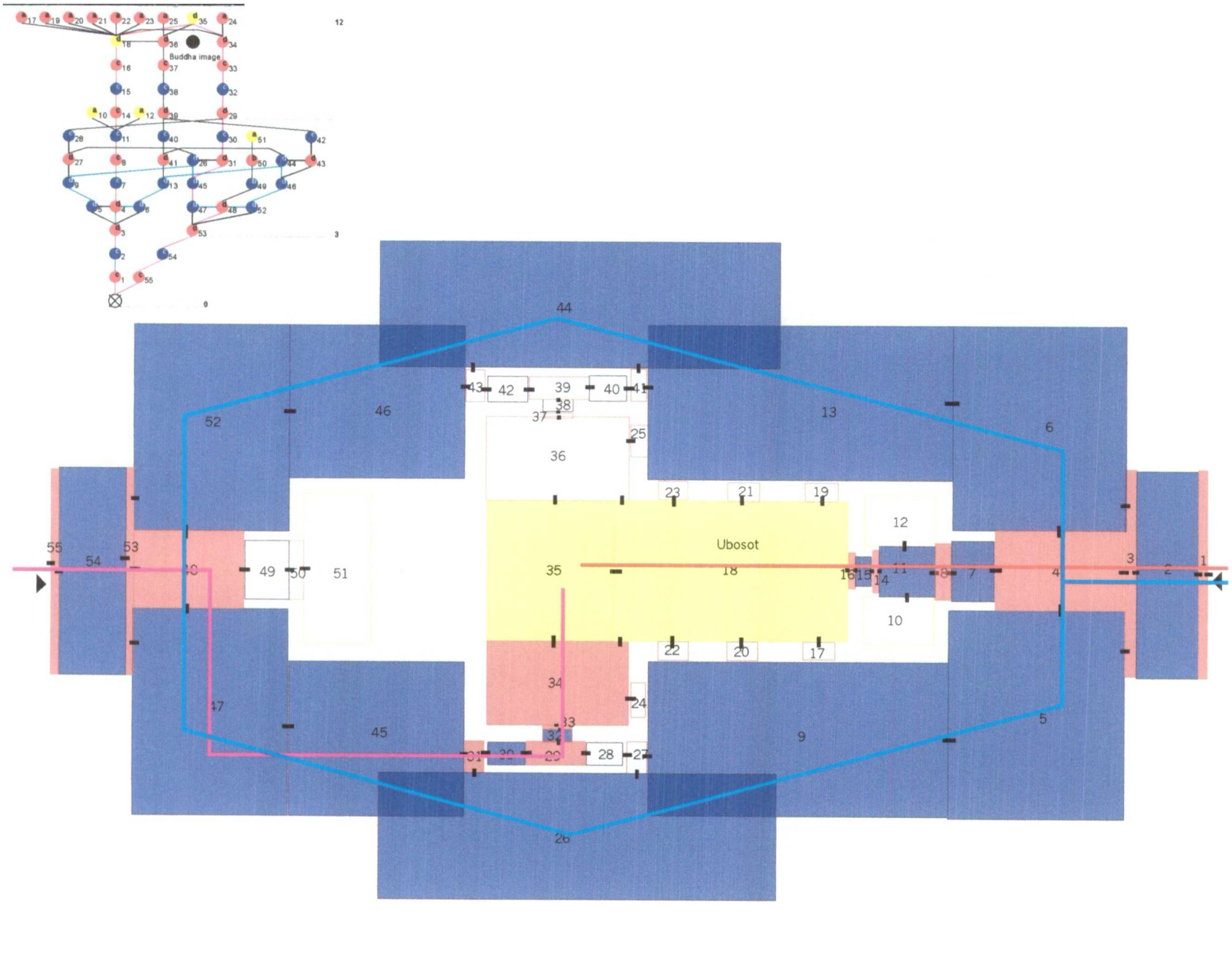


Figure 6.50a Temple 6 Route analysis

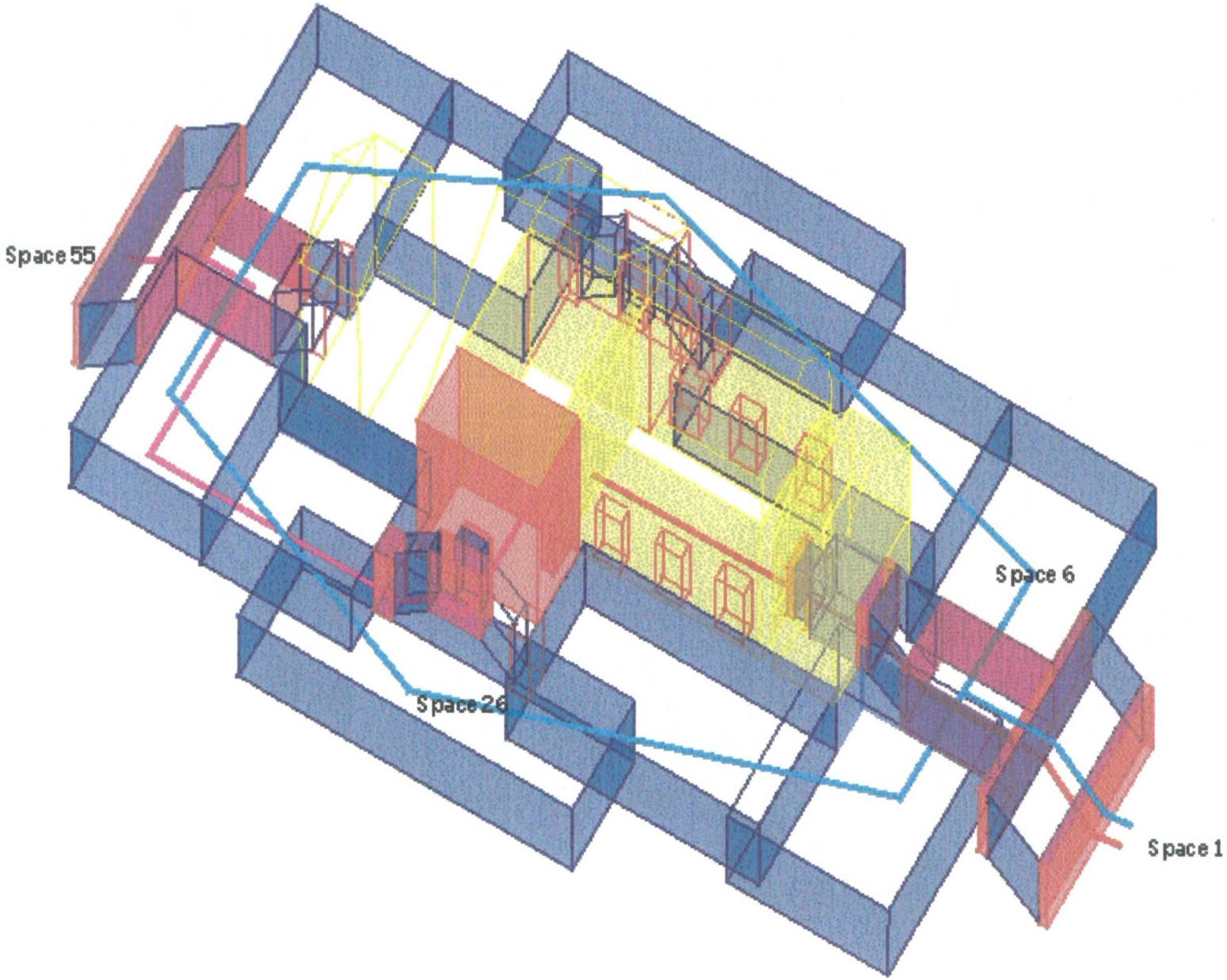


Figure 6.50b Routes in Temple 6

7. The conclusion

From the analyses, we have seen that architectural space is the interaction between concepts in design and reality of use and built objects. Four dimensions in architectural space illustrate this interaction which is read as a whole configuration of structure-experience-function-architectural element. However, it is proposed that we, designers and users of the building, approach these relations from opposite ends, from the structural and architectural-element dimensions respectively. Either way, a building is understood through the sense of bodily movement and the way we make use of it as a whole or in its important parts as argued in the route analysis.

This is why we can anticipate that, for example, experiences of going through a 'passage' usually have 'place' lying next to it with the possibility of finding 'junction' in between. People use specific routes because they can recognise certain characteristics of the space they are in or will be in and thus are able to predict or expect the movements they are going to make. The following argument is the conclusion of the analysis where the selected buildings are presented as spatial configurations which synthesise multiple readings of information into their spaces in conceptual forms. Relational syntax is this conceptual form which comprises the act of using and designing architectural space, from the way it is connected to other spaces in the structural dimension to how it is enveloped in the architectural-element dimension.

The elements in a relational syntax are presented in such a way that they can be read from abstraction to architectural reality. A relational syntax is a form of knowledge that is recognised as a sign which has its place among other signs; together these signs create knowledge of the space as a whole which can be seen as a design strategy as further analyses will show. However, as Lefebvre warns (1990), these signs are only representative and thus are not substitutes for reality. This is why in relational syntax all elements can be seen as descriptions of others. For example, the structural dimension describes space through topological properties such as location and connection while the experiential dimension describes the structural dimension through actual bodily movement in that space. In short, relational syntax is reality of many properties in the same architectural space.

The next question then concerns the realisation of the composites of these identical properties, which take different forms, into a whole that makes architectural sense. Deleuze uses the terms 'Identicals' and 'Definables' to explain the derivative nature of space (1993). 'Identicals' simultaneously present themselves in different dimensions in order to derive 'Definables' which has order that is derived from notions of many elements. The importance is that it is the derivative process not the combinatorial one that makes the 'Definables' possible. This nature of things is similar to the idea of relational syntax where the whole being or concept of architectural space 'as-is' is the derivation not the combination of different elements. Different dimensions in architectural space simultaneously exist in the same space and time.

Delueze explains the concept of things using the smallest unit, the primaries, since he seeks to explain it in structural way, however, from a metaphysical approach. He links the existence of things to the indivisible which appears to be a composite-based object presented to us in the form of an absolute such as architectural space. In the first place, space seems indivisible in a practical sense because each person using the space would have an indivisible conception of it or have a dominant picture of one of the dimensions inside that architectural space. In the case of architecture, the object has a superimposition of multi-dimensions that are not related in the 'one-after-the other' fashion. Rather it might be seen as having co-existence identities and thus the concept of the so-called 'relation' is the idea of transformation, or 'derivation', among dimensions.

The conclusion of this thesis shows, firstly, how relations construct an understanding of architectural space in the selected buildings. The relation analysis compares relations from the selected examples in terms of theory and design (Tables 7.1 and 7.2). The next analysis, design strategies discusses the 'way' these relations appear and the effects they create. For traditional Thai architecture, design strategies are closely linked with socio-cultural aspects which form the global frameworks for the part-whole and indoor/outdoor strategies. Finally, the relational syntaxes that characterise conventional and contemporary design of Thai houses and temples are discussed as well as potential uses of relational syntax in research and design.

Traditional Thai houses: **Houses 1 - 6**: Relational syntax

Syntax	Structural dimension	Experiential dimension	Functional dimension	Arch- element dimension	Number of space	Mean Int. value
1	a	→passage	→0			
2		→junction	→0			
3		→place	→living area	→terrace	= 2	0.832
3.1				→hall	= 3	0.709
3.2				→pavilion	= 3	0.630
3.3				→hallway	= 1	0.591
3.4				→courtyard	= 1	0.542
4			→bathroom	→room	= 22	0.699
5			→bedroom	→room	= 24	0.722
6			→kitchen	→room	= 1	0.663
7			→dressing rm.	→room	= 6	0.545
8			→storage	→terrace	= 3	0.908
8.1				→room	= 11	0.577
9			→bathing area	→terrace	= 2	0.814
10			→prayer hall	→hall	= 1	1.132
11			→pantry	→courtyard	= 1	0.609
11.1				→room	= 1	0.675
12			→study room	→room	= 2	0.704
13			→spirit room	→room	= 1	0.675
14			→dayroom	→room	= 2	0.845
15			→dining room	→room	= 1	0.589
15.1						
16	b	→passage	→circulation	→stairs	= 5	0.783
16.1				→terrace	= 1	0.781
17		→junction	→circulation	→doorway	= 8	0.833
18			→living area	→veranda	= 5	0.950
19			→foyer	→room	= 2	0.786
19.1				→veranda	= 9	0.660
19.2				→courtyard	= 1	0.781
20			→entrance	→terrace	= 1	0.642
21		→place	→bedroom	→room	= 7	0.639
22			→living area	→terrace	= 1	0.711
22.1				→veranda	= 1	0.837
23			→bathroom	→room	= 1	0.467
24			→living room	→room	= 1	0.820
24.1						
25	c	→passage	→circulation	→stairs	= 21	1.007
25.1				→terrace	= 6	0.969
25.2				→veranda	= 3	0.640
25.3				→courtyard	= 4	0.741
25.4				→hallway	= 1	0.691
26			→living area	→terrace	= 1	1.658
27			→garden	→terrace	= 1	0.499
28			→entrance	→stairs	= 4	1.025
28.1				→courtyard	= 1	1.002
29			→foyer	→courtyard	= 2	0.888
30		→junction	→circulation	→doorway	= 6	0.851
30.1				→terrace	= 5	0.982
30.2				→veranda	= 1	0.828
30.3				→stairs	= 3	0.978

30.4				→courtyard	= 3	0.922
31			→living area	→veranda	= 3	0.597
32			→entrance	→stairs	= 16	0.857
32.1				→terrace	= 1	0.760
33			→foyer	→veranda	= 2	0.684
33.1				→terrace	= 2	0.633
33.2				→room	= 2	0.774
34			→pantry	→room	= 1	0.611
35		→place	→living area	→veranda	= 2	0.928
35.1				→hall	= 1	0.931
35.2				→terrace	= 4	0.867
35.3				→pavilion	= 1	0.734
35.4				→courtyard	= 1	0.749
36			→bedroom	→room	= 3	0.582
37			→bathroom	→room	= 2	0.689
38			→storage	→room	= 1	0.725
39			→dressing rm.	→room	= 1	0.698
40			→pantry	→room	= 1	0.698
41	d	→passage	→circulation	→terrace	= 25	0.994
41.1				→courtyard	= 15	0.966
41.2				→room	= 1	0.677
42			→garden	→terrace	= 1	0.686
43			→entrance	→stairs	= 1	1.084
43.1				→courtyard	= 1	1.002
44		→junction	→entrance	→stairs	= 2	0.905
44.1				→courtyard	= 1	1.341
44.2				→terrace	= 2	0.862
45			→circulation	→terrace	= 15	1.017
45.1				→courtyard	= 5	0.844
45.2				→stairs	= 2	0.947
46			→living area	→veranda	= 7	1.288
47			→foyer	→veranda	= 1	0.808
47.1				→room	= 1	0.882
48		→place	→living area	→terrace	= 8	1.156
48.1				→veranda	= 3	1.511
48.2				→courtyard	= 3	0.768
48.3				→room	= 1	0.737
49			→dining hall	→pavilion	= 1	1.282
50			→garden	→terrace	= 2	0.771
51			→dining area	→room	= 1	0.850
51.1				→courtyard	= 1	0.927
52			→kitchen	→room	= 2	0.895
53			→living room	→room	= 1	0.763
54			→storage	→room	= 1	0.735
55			→bedroom	→room	= 1	0.732
Total space = **340** + 6 exterior spaces						

Table 7.1 Houses 1-6 relations

Traditional Thai temples: **Temples 1 – 6**: Relational syntax

Syntax	Structural dimension	Experiential dimension	Functional dimension	Arch- element dimension	Number of space	Mean Int. value
1	a	→passage	→circulation	→pavilion	= 2	0.503
1.1				→stairs	= 1	0.370
1.2				→terrace	= 2	0.515
2		→junction	→circulation	→terrace	= 171	0.630
2.1				→hallway	= 14	0.356
2.2				→courtyard	= 24	0.766
3			→orientation	→window	= 102	0.522
4			→prayer space	→terrace	= 6	0.443
5		→place	→garden	→courtyard	= 22	0.537
6			→rest area	→courtyard	= 17	0.683
7			→prayer space	→pavilion	= 2	0.513
7.1				→terrace	= 3	0.526
8			→prayer hall	→hall	= 1	0.540
8.1				→room	= 4	0.658
9			→storage	→room	= 2	0.645
10			→belfry	→pavilion	= 1	0.448
10.1				→terrace	= 2	0.763
11	b	→passage	→circulation	→hallway	= 4	0.433
11.1				→stairs	= 5	0.675
12		→junction	→circulation	→doorway	= 2	0.552
12.1				→terrace	= 5	0.627
13		→place	→rest area	→courtyard	= 6	0.650
14	c	→passage	→circulation	→stairs	= 105	0.640
15			→entrance	→gateway	= 28	0.856
15.1				→courtyard	= 40	0.714
15.2				→cloister	= 23	0.714
15.3				→terrace	= 83	0.637
15.4				→hallway	= 4	0.535
15.5				→pavilion	= 6	0.572
16		→junction	→circulation	→cloister	= 467	0.758
16.1				→terrace	= 165	0.728
16.2				→doorway	= 109	0.568
16.3				→hallway	= 12	0.499
16.4				→courtyard	= 23	0.623
16.5				→stairs	= 10	0.590
16.6				→pavilion	= 2	0.717
17			→entrance	→gateway	= 78	0.748
17.1				→terrace	= 4	0.575
18			→office	→room	= 57	0.538
19			→prayer hall	→room	= 19	0.503
19.1				→cloister	= 2	0.868
19.2				→hall	= 1	0.564
20			→storage	→room	= 8	0.445
21			→foyer	→hall	= 2	0.577
22		→place	→rest area	→courtyard	= 11	0.774

23			→storage	→room	= 5	0.585
24			→prayer space	→pavilion	= 4	0.434
24.1				→terrace	= 3	0.692
25			→prayer hall	→hall	= 2	0.444
26	d	→passage	→circulation	→terrace	= 140	0.773
26.1				→cloister	= 64	0.820
26.2				→courtyard	= 57	0.757
26.3				→room	= 16	0.732
26.4				→hallway	= 8	0.505
27			→foyer	→room	= 27	0.588
28			→office	→room	= 9	0.604
29			→prayer hall	→room	= 6	0.549
29.1				→hall	= 3	0.807
30			→storage	→room	= 4	0.483
31		→junction	→circulation	→terrace	= 83	0.741
31.1				→cloister	= 52	0.883
31.2				→courtyard	= 22	0.708
31.3				→doorway	= 2	0.431
31.4				→hallway	= 2	0.410
31.5				→stairs	= 3	0.698
32			→foyer	→cloister	= 3	0.770
32.1				→hall	= 2	0.734
33			→entrance	→gateway	= 1	0.716
34			→prayer hall	→hall	= 1	0.632
35		→place	→prayer hall	→room	= 28	0.597
35.1				→hall	= 7	0.578
35.2				→cloister	= 1	0.903
36			→prayer space	→room	= 8	0.707
36.1				→terrace	= 11	0.700
36.2				→hall	= 3	0.608
37			→bench	→terrace	= 8	0.573
38			→foyer	→terrace	= 4	0.701
39			→office	→room	= 60	0.569
40			→storage	→room	= 6	0.455
41			→garden	→courtyard	= 7	0.706

Total space = **2369** + 6 exterior spaces
Table 7.2 Temples 1-6 relations

7.1 Relation analysis

Numerical data: Tables 7.1-7.2 (p.403-406), 7.1.1-7.1.6 and 7.2.1-7.2.6 (appendix)

Graphical data: Figures 7.1-7.12

Houses 1-6 (Tables 7.1.1-7.1.6)

The relation that has the highest integration value is c-passage relation in both houses 1 and 2. House 1 generates a wide range of c-based relations while house 2 has a more balanced proportion of a-, b-, c- and d-type spaces. House 2 has strong characters of b-, c- and d-based relations. House 3 has a very strong character of a-place-bedroom-room relation with the highest number of spaces of all relations in houses (10) while d-based relations, as usual, have the highest mean integration value. Houses 4 and 5 similarly have a high number of spaces in a-place, c-passage and d-passage relations. Space in house 4 is more fragmented than in house 5 reflected in its large proportion of c-passage relations (18). The proportion is more balanced in c- and d-based relations in house 5. Houses 4 and 5 have strong d-passage relations in both number of spaces and integration values; the relation is very influential in the structure of house 6 where it produces the highest integrated spaces in the house (1.129). House 6 has a very strong character and the largest proportion of a-place relations (53%) which are all made into rooms. As a result, house 6 as a whole has a large proportion of b-based relations (19%) while house 3 has the smallest proportion of b-based relations (3%).

From on-site observation, it is obvious that the circulation-terrace relation is dominant in the design of Thai houses. In all selected houses, the open terrace is very distinctive and forms relations with almost every element from other dimensions. bedroom-room relation is the most fixed and found in all selected Thai houses. The smallest number of bedroom-room spaces is in house 1 (3) where there is a very strong character of circulation-doorway, a characteristic relation of the conventional Thai house (Figure 7.1). In house 2, circulation-based relations are very visible in the form of doorway, stairs and terrace which influence the highly open-plan character of the house (Figure 7.2). Similar to house 2, the highest integrated space in house 3 is living area-terrace relation. House 3 is a very straightforward design with *chan* space flanked by 10 bedroom-room spaces creating strong living area-veranda relation which is usually located next to bedroom-room relation as the buffer zone between rooms and *chan* space (Figure 7.3).

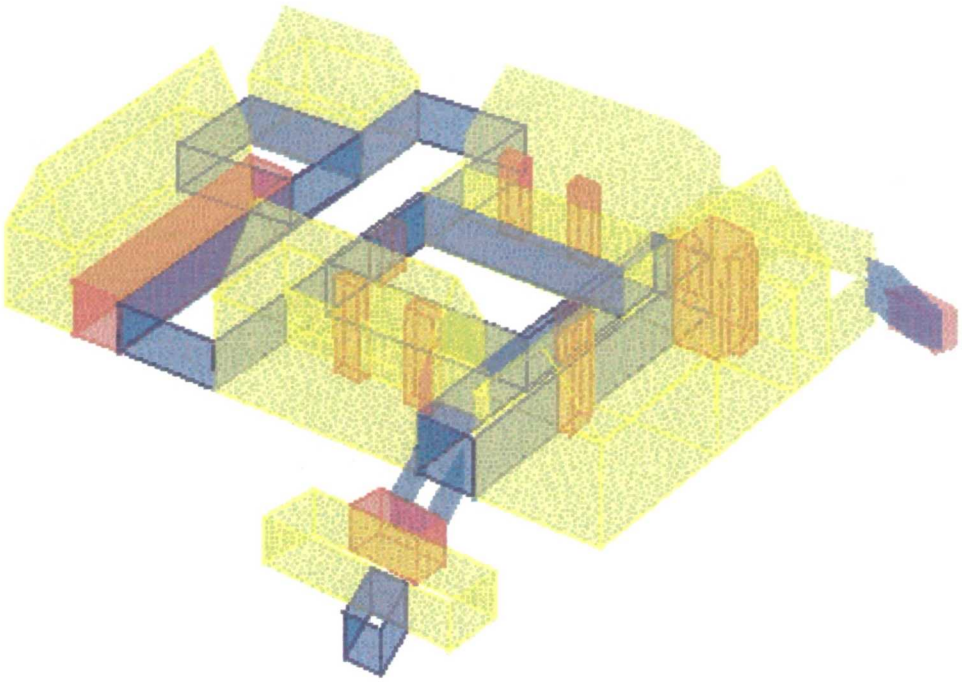


Figure 7.1 Axonometric drawing of House 1

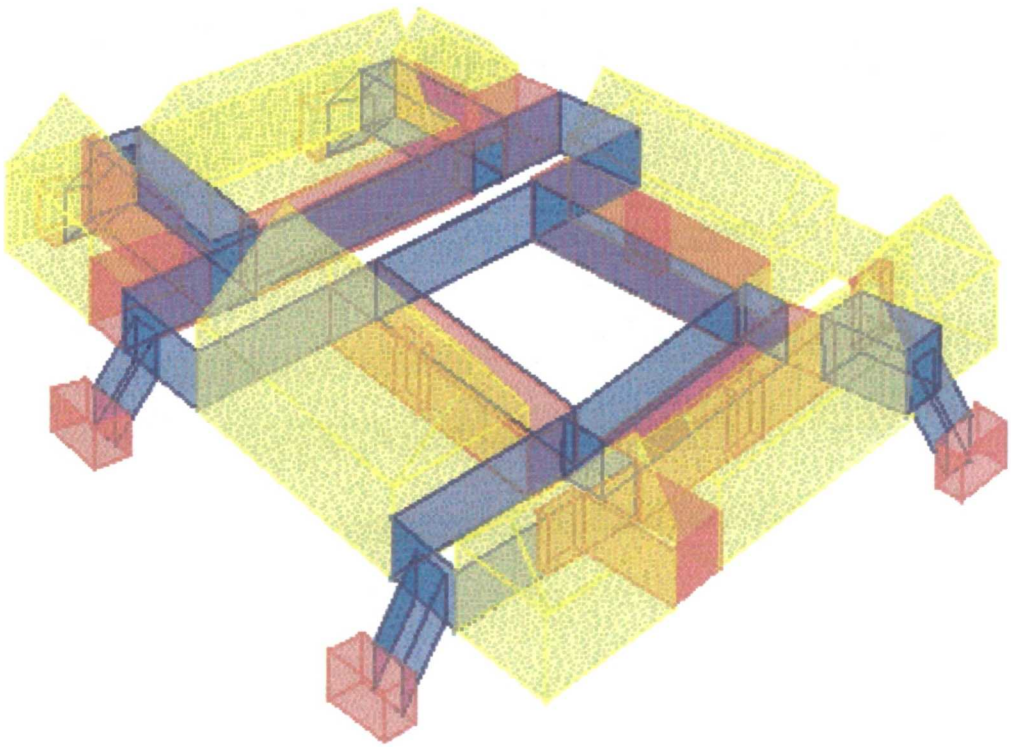
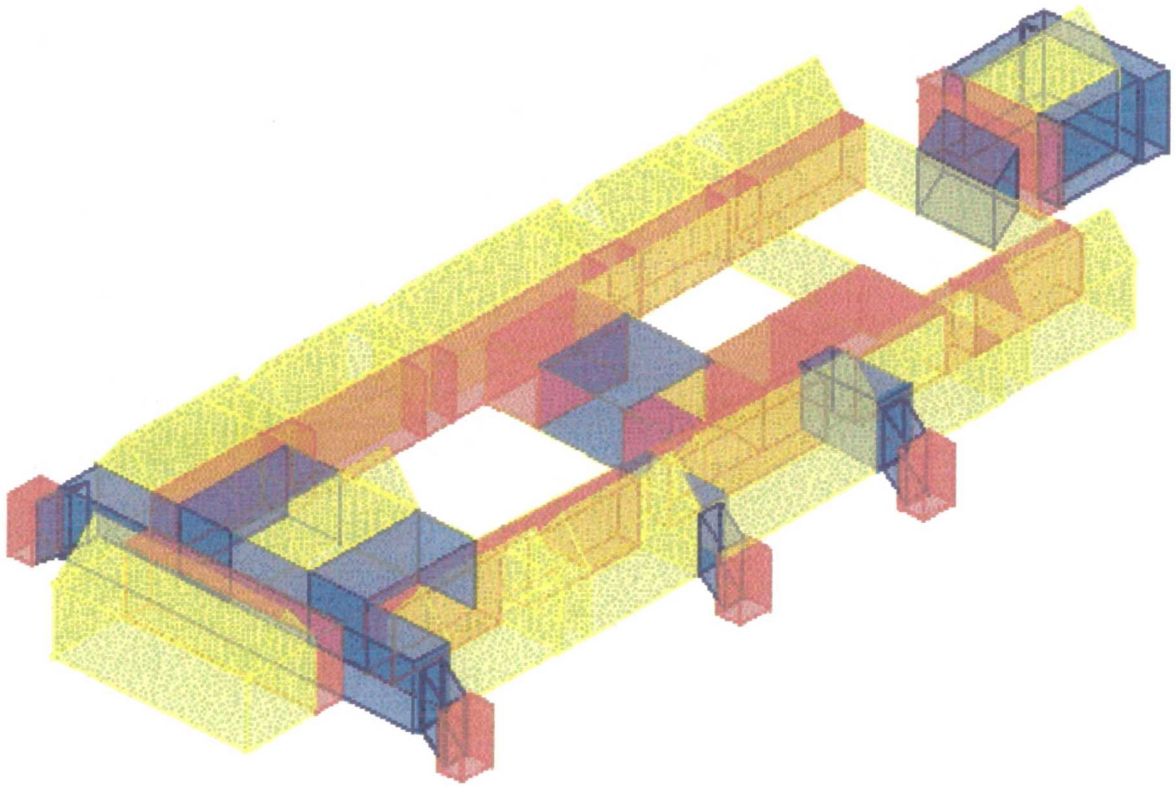


Figure 7.2 Axonometric drawing of House 2



Passage Junction Place

Figure 7.3 Axonometric drawing of House 3

House 4 has the highest number of circulation-terrace spaces in all houses (16) due to its extensive first floor. The house also has a rich variety of room-based relations on both floors. Similar to many contemporary Thai houses, houses 4 and 5 incorporate their ground floor using the circulation-courtyard relation that has the semi-enclosed character (Figures 7.4-7.5); it has the highest integration value in house 4 (1.084). One courtyard accommodates various functions, e.g. circulation, entrance, living area and parts of pantry. House 5 has fewer spaces with courtyard-based relations than house 4 but they hold key functions such as dining and living area. Some of the conventional living area-veranda space are preserved in contemporary houses 4 and 5 for symbolic purposes while many are transformed into foyer-veranda spaces to gain more room-based spaces. Because of limited space, house 6 is no longer based on terrace spaces but on small courtyard and room-based relations (Figure 7.6).

Table 7.1 is the conclusion of all relations that appears in all selected Thai houses. The d-passage-circulation-terrace relation is the most frequent relation created (25 spaces) and the most dominant relation in the important parts of the selected houses as seen in route analysis. a-place-bedroom-room and a-place-bathroom-room relations together create the largest proportion of space in all relations of the selected house spaces (14%). These room-based relations are the main structure of the houses, implying a design orientation based on the concept of privacy. However, the largest proportion of Thai house space is not based on static a-type but on the more dynamic d-type space which seems to explain the dynamism in Thai house designs. In addition, b-type based relations are the least used in Thai designs (13 relations) leaving a-place in direct contact with dynamic c-and d-based relations.

c-passage-circulation-stairs relation usually connects interior to exterior space. This characteristic relation defines Thai houses where the main living spaces are on the first floor. The platforms at the end of the stair function as entry points and create c-junction-entrance-stairs relations which is directly connected to exterior space with a moderate mean integration value (0.857). The most integrated relation is d-place-living area-veranda (1.511) with the highest number of spaces in house 3. Living areas in Thai houses are quite extensive and flexible to various functions forming relations with all structural type spaces and all kinds of architectural elements both indoor and outdoor. d-place-living area-terrace is the most common relation in the selected Thai houses.

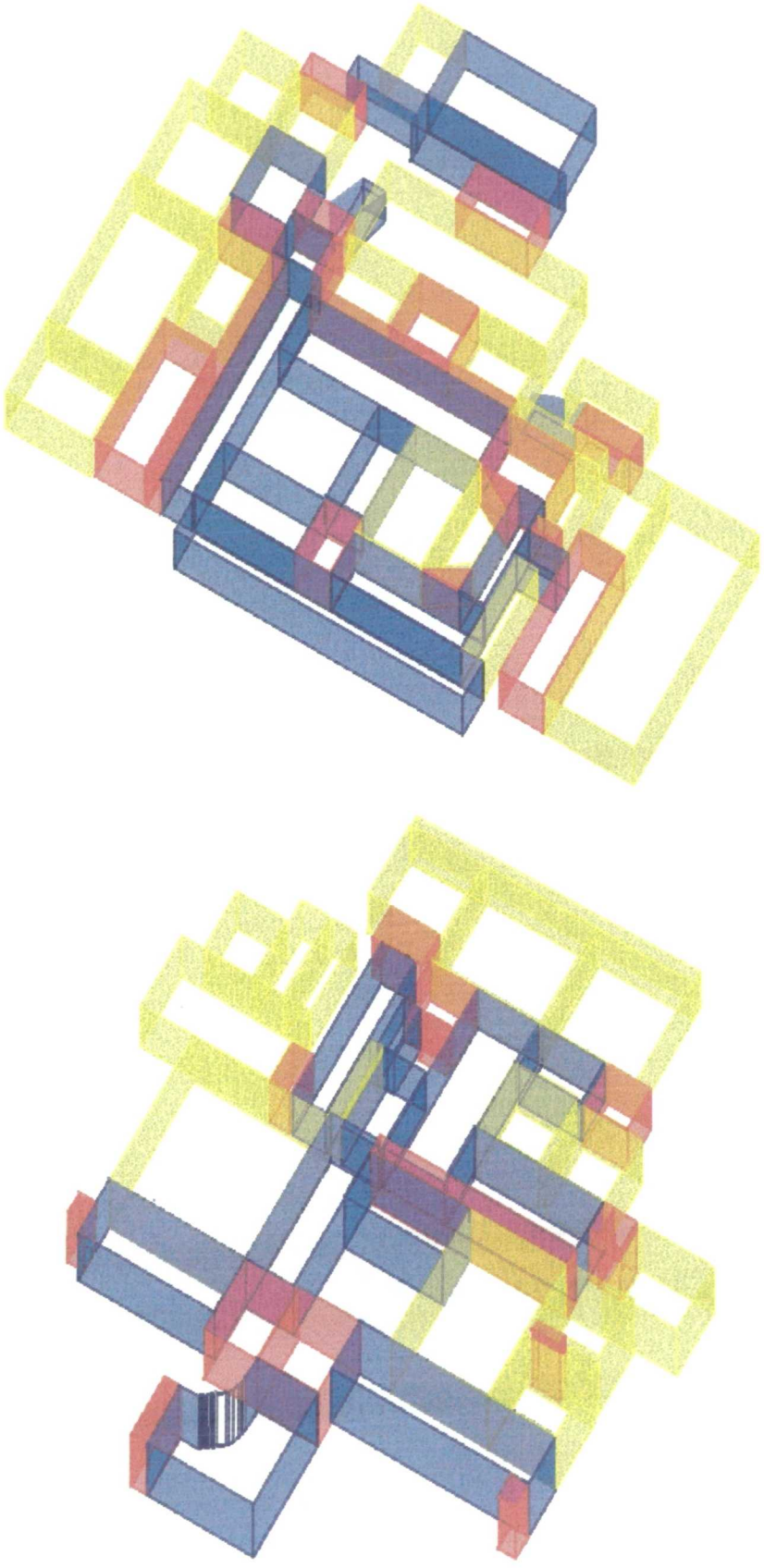


Figure 7.4 Axonometric drawing of House 4

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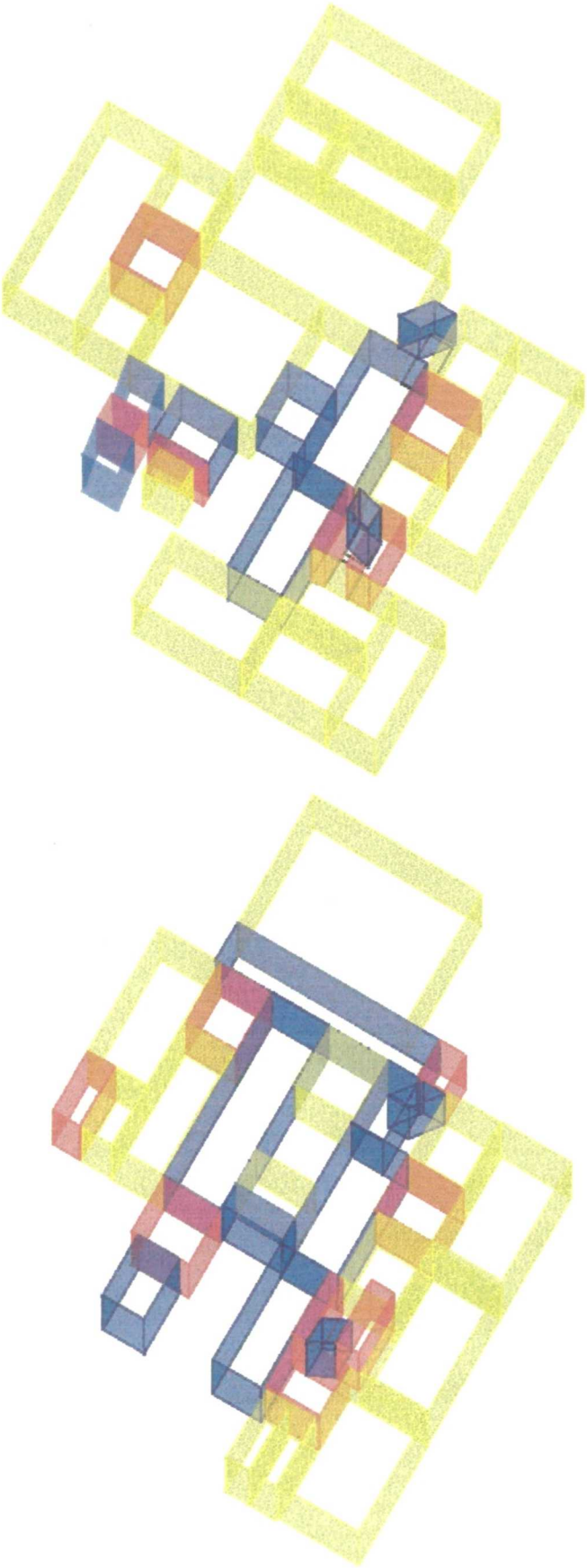

Figure 7.5 Axonometric drawing of House 5

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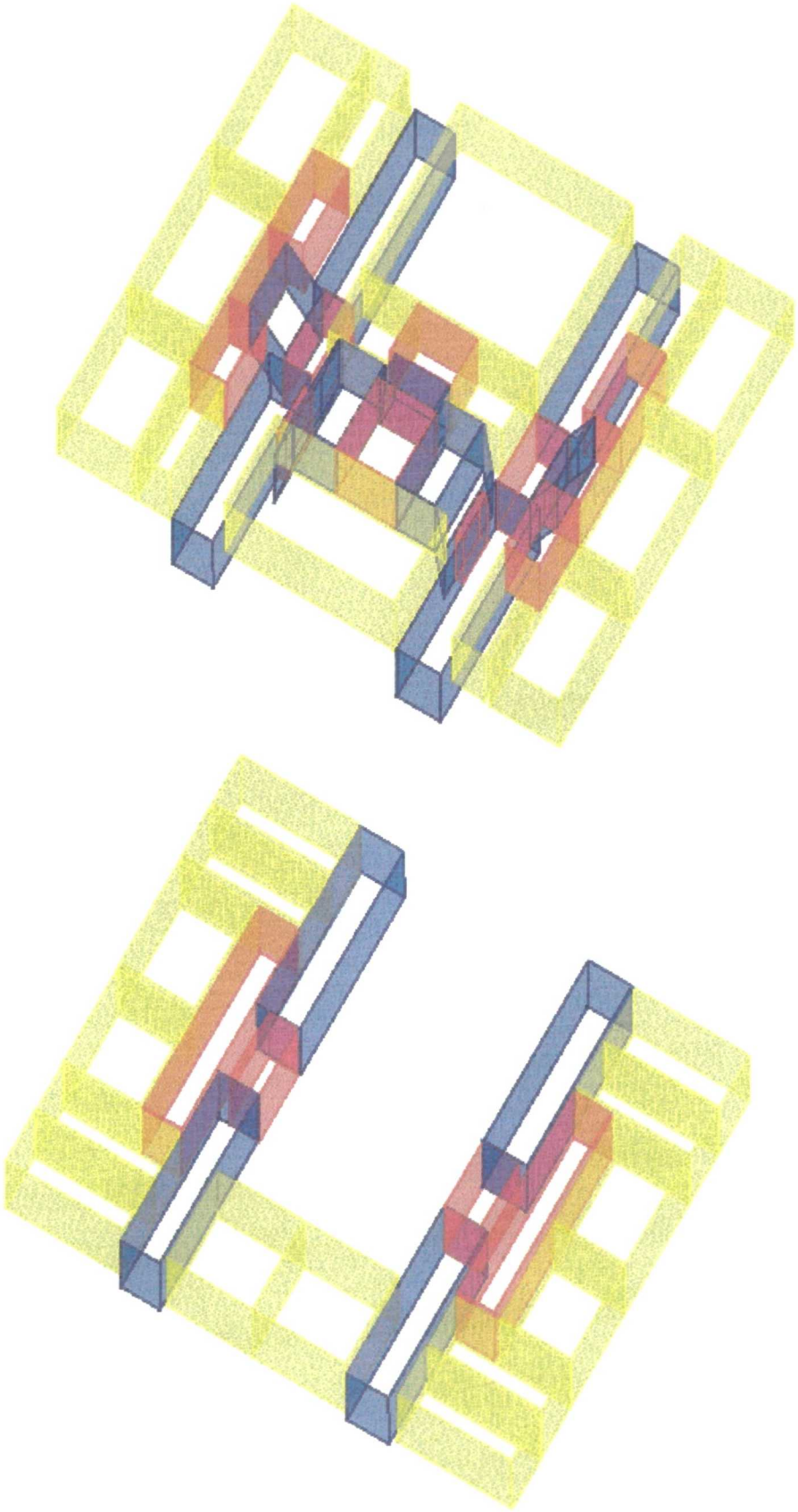


Figure 7.6 Axonometric drawing of House 6

413

a-passage and a-junction based relations are not applied to the space of Thai houses. Considering that house spaces are highly practical, the absence of these two relations from the selected Thai houses suggests the symbolic nature of the relations. In conclusion, there are 91 relations in 340 spaces of six Thai houses. b-junction-circulation-doorway and a-c-place-living area-pavilion relations seem to characterise the conventional designs. Courtyard-based and varieties of room-based relations characterise contemporary designs. There are 40 relations that happen only once in one space many of which are in the contemporary houses. This fact indicates the individual character of Thai house as 'the architecture of dynamic possibilities'; this effect is achieved through design strategies discussed in detail in the next analysis.

Temples 1-6 (Tables 7.2.1-7.2.6)

In contrast to the 'possibilities in activities' of house architecture, Thai temples seem to be 'the architecture of dynamic rules'; that is, each temple space has been strictly pre-designed according to religious rules and then individually configured to incorporate dynamic effects. 32% of temple 1 space is c-junction-circulation-cloister relation which, together with d-passage-circulation-cloister, shows that the temple space is largely enveloped by layers of circular movement. As seen in route analysis, d-passage-circulation-terrace is a very important relation in Thai temples however its number and integration value is not the most distinctive in temples 1 and 2. In contrast to Thai houses, there are a-junction based relations in temples such as a-junction-circulation-terrace and a-junction-orientation-windows which are considerable in number of spaces in temples 1 and 2; these relations are highly symbolic and highly necessary for temples.

Temple 2 is the largest of the selected temples creating the widest range of different relations (54); it is the only selected building that has all 12 structure-experience relations. Proportionally, all selected temples have a balanced proportion of c- and d-based relations with very small b-based relations. Temples 1 and 2 are very similar in many details, for example, the large number of spaces in c-junction-circulation-cloister (236 and 210 spaces, respectively) and the small but very important d-passage-circulation-terrace relations. Temple 3 also has a large proportion of c-junction based relations with the highest integrated d-passage-circulation-terrace relation. There is no b-type relation in temples 1 and 3 suggesting a well-connected spatial configuration.

In contemporary Thai temples, the proportions of c- and d-based relations become more balanced in terms of number of relations and spaces than in the conventional ones. d-based relations are more emphasised in contemporary temples and eventually outgrow c-based relations in temple 6. There are also more b-based relations in contemporary temples while a-based relations are consistent in symbolic importance in all selected temples. a-junction is the most noticeable with a-place relations becoming more visible in contemporary temples. Temple 4 has the widest range of different a-based relations (5) and the highest number of different relations in the selected contemporary temples (22). Temple 5 has a strong proportion of d-based relations dedicated to religious activities with the highest integration value in both c-junction and d-passage relations. Temple 6 also has very integrated d-passage spaces (10) which are the largest proportion of all temples (18%).

Apart from the most dominant circulation-cloister relations, temples 1 and 2 are largely configured by terrace-based relations; the most important is d-passage-circulation-terrace which defines overall understanding of all the selected temples. Temple 1's design is formed using mainly cloister and terrace-based relations and thus movement not static function generate the building (Figure 7.7). In this way, sacred places pay great attention to the start and stop of movement and control it with entrance-gateway relations which has the highest integration value in temple 1 (1.063) without a large number of spaces (32 spaces or 4%). Temple 2 contains a higher proportion of entrance-gateway relations (8%) to serve its dual centre design (Figure 7.8). All movement inside a temple space comes to a stop at the centre of the temple where the space forms d-place-prayer hall-hall relations which has the highest number of spaces (3) in temple 2. This large proportion of d-place-prayer hall-hall relations influences the largest number of transition-typed relation (e.g. hallway- and doorway-based relations) in temple 2.

In temple 3, the prayer hall-hall relation is completely shielded from outdoor space by omitting one of the characteristic relations in Thai temples: orientation-window relation (Figure 7.9). Another way to achieve sacredness in conventional Thai temples is the employment of circulation-cloister relations which form the largest proportion of temple 3 spaces. Combining accessibility and control, the entrance-gateway relation is usually inserted along the cloister which is abandoned in contemporary temples along with the control aspect of the insignificant entrance-gateway relation. Temples 4, 5 and 6 are

heavily oriented on c- and d-passage-circulation-terrace relations (Figures 7.10-7.12) reflecting in their high number of spaces and the highest integration value of d-passage-circulation-terrace relations. Temples 4 and 5 have many prayer space-terrace relations while temple 6 is the most terrace-based design containing the smallest varieties of relations (16).

In conclusion, Thai temples consist of three main parts: the core at the *ubosot*, transition at the terraces and boundary at the entrance. Three most important relations in each of these three areas are d-place-prayer hall-hall in the *ubosot*, d-passage-circulation-terrace on the terraces and c-junction-entrance-gateway relations on the boundary. These basic relations create a general notion of sacredness in Thai temples. However, these three relations are not highly visible among other relations in terms of numerical data but they are irreplaceable in terms of design. In the six Thai temples, the main prayer halls all appear as d-place types. This space can sometimes be sectioned into two spaces for monks and worshippers as in temple 6's *ubosot*. From table 7.2, there are 7 d-place-prayer hall-hall spaces with a moderate mean integration value (0.578) indicating that the relation is in spaces that are not well integrated with the whole spatial configuration. In design and in use, however, this relation is simultaneously the beginning and the end of activities; in temples all relations exist because of d-place-prayer hall-hall relation.

A Thai temple usually establishes visual structure between its *ubosot* and the rest of the temple by a symbolic relation of a-junction-orientation-window which has no use other than being there as point of reference from both inside and outside the *ubosot*. There are high numbers of spaces with this relation (171) with a higher mean integration value than the prayer hall (0.63); these spaces are highly visible from the d-passage-circulation-terrace relation which is in 139 spaces with high integration value (0.775). Temple terraces influence a large number of other relations such as the symbolic a-junction-circulation-terrace and c-junction-circulation-terrace which connects passage-based relations and redirects the flow of movement on the terraces.

The c-junction-circulation-cloister relation is the most common or frequently experienced element in conventional Thai temples with the largest number of spaces in all relations (467). It is used to define and enclose the religious area of a temple and at the same time integrates and draws movement from the outside with its high mean

integration value (0.758). However, contemporary designs rarely have cloister-based relations placing the integrated effect on terrace-based relations instead. This is often achieved by using multi-level terrace designs resulting in d-passage-circulation-terrace relation becomes even more important in contemporary temples. Whether it is a cloister or terrace-based structure, Thai temples usually have clear demarcation points with c-junction-entrance-gateway relation which has a high integration value (0.748). Many of c-junction-entrance-gateway spaces are used in conventional temples by incorporating them into cloister spaces at the boundary of the religious area. On the other hand, only a few entrance-gateway spaces are used in the selected contemporary temples. The relation is often in the spaces before the doorways that lead to the prayer hall inside the *ubosot*. In this way, the religious boundary of a contemporary Thai temple is contracted into small area of indoor space which in turn increases the integration value of the d-place-prayer hall-hall (Tables 7.2.4-7.2.6).

The selected temples have a similar proportion of a-based relations to houses leading to the fact that a-place usually represents 'privacy' while a-junction usually signifies 'sacredness'. b-based relations are very few in both types but more compatible with the concept of privacy in houses. Temples 1 and 3 have no b-based relations and only temple 2 has a b-place relation. The proportion of c- and d-based relations is also interestingly comparable between the selected Thai examples; that is, the number of c-based is higher than d-based relations in houses (31 in comparison to 26) while there are 26 c-based and 31 d-based relations in the selected temples. It seems that theoretical properties have been correctly conceived in reality such as the segregated c-based relations (especially c-junction) are dominant in privacy-oriented architecture like houses or used to define sacredness in cloister spaces. d-based relations are greater in number in temples and d-passage based relations have the highest integrated effect.

In conclusion, there are 80 relations created in the 2369 spaces of six selected Thai temples. Only 7 relations happen once in only one space compared to 40 in houses showing that certain rules predetermine temple designs and are strictly followed by the architects. These rules, however, are dynamic because they generate a large variety of relations as well as many architectural designs. Relations such as c-junction-circulation-cloister and the increasing of number and integration value of d-passage-circulation-terrace respectively characterise conventional and contemporary designs. As seen in

'privacy' concept of Thai houses, this analysis explains how the concept of 'sacredness' is configured into the space of Thai temples. The analytical explanation of both effects in this analysis will be seen in action as design strategies in the next analysis.

The relation analysis has discussed the selected examples in further depth looking at specific relations in real spatial configurations. Various relations discovered in architectural space are now seen as relational, not elemental, that take place within a whole discourse of architectural reality. The next analysis will look further into the evolution of these relations from the abstraction of pure space to practical use in architecture in specific environments created by intuition in design process. This evolution is not necessarily seen from only the architects' point of view but in a collective view of design as a socio-cultural activity of a mature society.

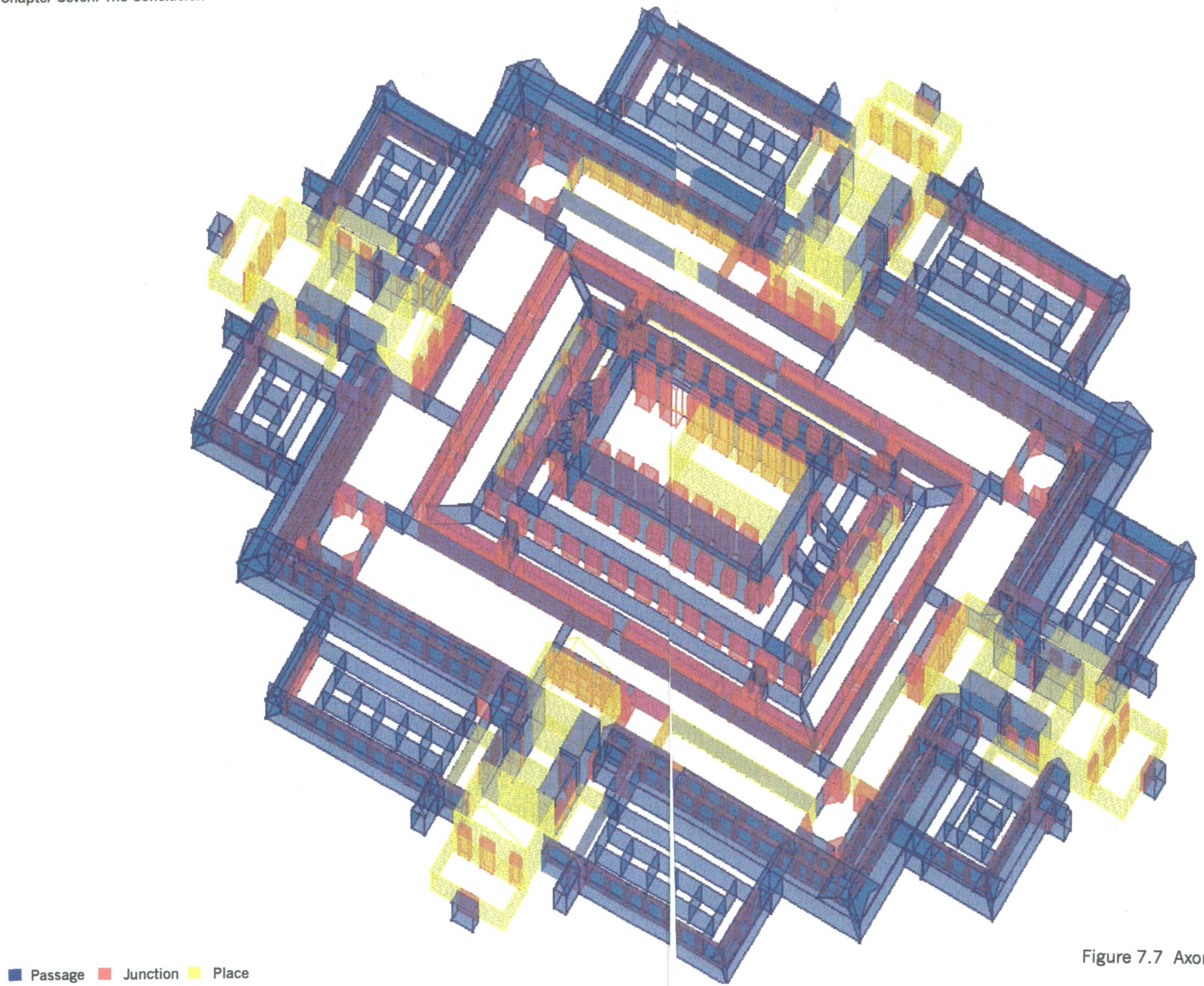


Figure 7.7 Axonometric drawing of Temple 1

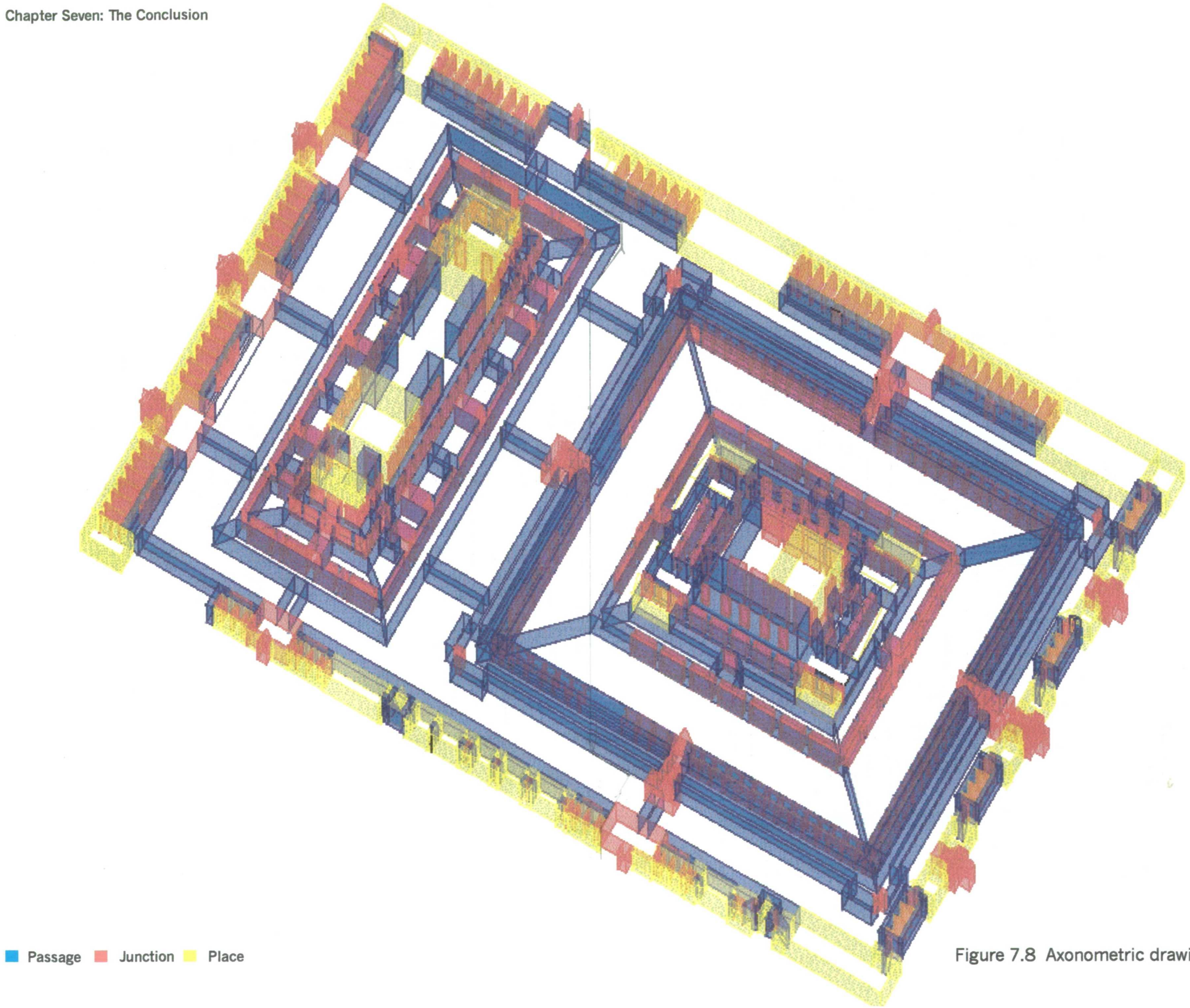


Figure 7.8 Axonometric drawing of Temple 2

Figure 7.9. Axonometric drawing of Temple 3

Figure 7.10 Axonometric drawing of Temple 4

Figure 7.11 Axonometric drawing of Temple 5

Figure 7.12 Axonometric drawing of Temple 6

Passage Junction Place

7.2 Design strategies

Numerical data: Tables 7.3-7.4 (appendix), 7.3.1 (p.428), 7.3.2 (p.437), 7.3.3 (p.441), 7.4.1 (p.446), 7.4.2 (p.454) and 7.4.3 (p.458)

Graphical data: Figures 7.13-7.34

In relation analysis, the discussion was based on individual buildings and relations inside their space. There are some distinct relations that are shared by most or all the selected buildings. These relations are in real experience as much as in the concept of the architecture. In the selected Thai houses, a-place-bathroom and a-place-bedroom-room are the most basic relations while c-passage-circulation-stairs, c-junction-entrance-stairs and d-place-living area-terrace are other major relations. Some relations appear only in conventional houses, e.g. c-junction-circulation-doorway and c-junction-living area-veranda, or only in contemporary houses, e.g. courtyard-based relations. The most common relation in the selected Thai houses is d-passage-circulation-terrace which is also a very important relation in the selected Thai temples.

a-junction-orientation-window, c-junction-entrance-gateway and d-place-prayer hall-hall are the major relations in Thai temples. There are some relations such as c-junction-circulation-cloister that appear only in conventional temples or a-place-belfry-pavilion and a-place-belfry-terrace relations that are only in contemporary temples. As this information about 'what' makes each building are made clearer by explaining the reason 'why', we now left with general concepts of these relations. The concept is not concerned with the fact whether it is house 4 or temple 2 but with 'how' these relations evolve and how they are used in designs. These two questions are considered to be 'architectural' and thus involve design strategies in order to execute the concept. As outlined in chapter three, Thai designs can be linked to socio-cultural, part-whole and indoor/outdoor strategies; that is, the design of architecture in most cultures must fit in three scales: a society, a building and a detail.

The following investigation looks into all the relations appearing in the selected buildings and explains 'how' these relations evolve and are used as design strategies that are significant in Thai house and temple architecture. The focused relations are those that have appeared significant in terms of number of occurrences and their uses in reality as have been shown in earlier analyses. In this way, one relation becomes significant

because of its multi-dimensional properties; that is, a relation has high syntactic values in its structural dimension or it is a common experience in the experiential dimension of the buildings. In the functional dimension, a significant relation is often the one that contains the basic and most used functions of the buildings while in the dimension of architectural element this relation is often in characteristic parts of the designs. These structure-experience-function-architectural element relations are read mainly from the way space evolves into architecture or from structural to architectural element dimensions. However, a relation is an architectural space and is therefore an object with meanings which is understood by the reading of its extrinsic, e.g. 'h-o-m-e', which is the intrinsic work of syntax in that relation.

A relational syntax can comprise many relations; that is, the same spatial structure can evolve into various architectural elements. To illustrate how a dominant relational syntax is realised from other variations, an example from a-place-living area-?, house syntax 3, is shown below.

Structure	Experience	Function	Arch. element	No. of space	Integration value
Syntax 3: a-place-living area-?					
House 1					
a	→place	→living area	→hall	= 2	0.647
House 2					
a	→place	→living area	→pavilion	= 2	0.674
			→hall	= 1	0.834
			→terrace	= 1	0.834
House 3, 6					
a	→place	→living area	→0		
House 4					
a	→place	→living area	→terrace	= 1	0.829
			→hallway	= 1	0.591
House 5					
a	→place	→living area	→courtyard	= 1	0.859
			→pavilion	= 1	0.542

Since relational syntaxes are genotypes of design strategies, the most distinct relation in the relational syntax is considered to be of general use and thus defines and dominates the concept of that relational syntax. First of all, the number of buildings where a relation appears indicates how common this relation is used in the designs of this type of building. Secondly, the frequency of a relation's occurrence is considered to be important. Thirdly, the integration value of a relation suggesting how much this relation affects its context as a whole; it is useful when assessing the effectiveness of the relation in great detail and when comparing across many relations and examples. From the above

example, house syntax 3 is realised into a-place-living area-hall (3 times) or a-place-living area-pavilion (3 times) both in two houses with an average integration value of 0.709 and 0.63, respectively. Therefore, a-place-living area-hall relation seems to be stronger than a-place-living area-pavilion only in its effect to the whole. With these criteria, the dominant relational syntaxes from the selected examples will be discussed in detail as they are seen as major design strategies of these buildings.

Starting from the largest scale, the analysis discusses 'what' these important syntaxes are seen as from within Thai society through the consideration of socio-cultural strategies inscribed in the buildings. Part-whole strategies are applied when the syntax is seen as parts of a piece of architecture and 'why' the syntax is what it is in our understanding. This self-referential concept illustrates a practical understanding of the way different syntaxes work together in their environment by comparing the structural impacts they have on the whole configuration. Finally, relational syntax is seen as a tool and 'how' it is used to create specific designs in indoor/outdoor parts of the selected buildings. In some spaces, one strategy can be more dominant than the other two in the process of design. However, all three strategies are present in all convex spaces of all syntaxes because in reality a building's space is understood as one. The following analysis aims to make clear the concepts of these three strategies using some interesting spaces from the selected buildings as examples. These design strategies will be illustrated with axonometric drawings and pictures of spaces in the syntax under discussion.

Houses 1-6 (all relational syntaxes in table 7.3, appendix)

Syntax 4, 5, 25, 30 and 41 are realised in all selected Thai houses. Syntax 4 and 5 (Table 7.3.1) are a-place-bathroom-room and a-place-bedroom-room, respectively. The most dominant relation in syntax 25 (Table 7.3.2) is c-passage-circulation-stairs while it is c-junction-circulation-terrace in syntax 30 (Table 7.3.2) and d-passage-circulation-terrace in syntax 41 (Table 7.3.3). Tables 7.3.1-7.3.3 are parts of table 7.3 where we can see that Thai house architecture generates large variations of a- and place-type syntax. The domination of a-type space seems to be common in houses of many cultures (Hanson, 1999). However, the selected Thai houses have their largest proportion of space as the segregated c-type spaces used to retain 'privacy' (sections 5.2-5.3). Furthermore, syntax 41, d-passage-circulation-terrace, contains the highest number of spaces in all of the most

common five syntaxes in the selected houses (25). In this way, Thai houses keep the 'dynamism' alive whilst maintaining the strict requirement of 'privacy'.

Structure	Experience	Function	Arch. element	No. of space	Integration value
Syntax 4: a-place-bathroom-?					
House 1					
a	→place	→bathroom	→room	= 2	0.635
House 2					
a	→place	→bathroom	→room	= 1	0.640
House 3					
a	→place	→bathroom	→room	= 1	0.950
House 4					
a	→place	→bathroom	→room	= 4	0.532
House 5					
a	→place	→bathroom	→room	= 6	0.747
House 6					
a	→place	→bathroom	→room	= 8	0.739
Syntax 5: a-place-bedroom-?					
House 1					
a	→place	→bedroom	→room	= 1	0.682
House 2					
a	→place	→bedroom	→room	= 1	0.612
House 3					
a	→place	→bedroom	→room	= 10	0.872
House 4					
a	→place	→bedroom	→room	= 2	0.834
House 5					
a	→place	→bedroom	→room	= 3	0.697
House 6					
a	→place	→bedroom	→room	= 7	0.506

Table 7.3.1 Relational syntax 4 and 5 of houses 1-6

Socio-cultural strategies:

'Room' is the dominant element that completes syntax 4 and 5. In all selected Thai houses, syntax 4 and 5 are located on the periphery of the living compounds in order to provide the maximum privacy possible to the space. In houses 1 and 2, syntax 5 is servant bedrooms at the back of the houses (spaces 31 and 39, respectively) while the main bedrooms (syntax 36 and 21, respectively) occupy the middle parts of the houses (Figures 7.13-7.14). In houses 3 and 6, the syntax is in the monk living units which are arranged for the maximum privacy since Buddhist monks study in isolation and are allowed only minimum belongings and space. Conventional monk compound such as house 3 is very similar to extended family houses which can grow to receive more occupants. House 6 is divided into small blocks employing the conventional concept of a self-governed community under an abbot. Therefore, the designs of houses 3 and 6 are heavily oriented toward the abbot units where common facilities such as the prayer hall (syntax 10) and dining room (syntax 15) are located (Figures 7.15-7.16).

In houses 4 and 5, the syntax is in the servants' living units. This situation is similar to houses 1 and 2 where the main bedrooms are not dead end spaces and are sectioned to accommodate other functions such as dressing rooms or are equipped with private bathrooms in contemporary cases (Figures 7.17-7.18). Bedrooms in Thai houses usually have buffer space with veranda-based relations which can also be used to receive guests (e.g. syntax 18, 19 and 46). Veranda space is used to accommodate various functions in the selected contemporary houses; e.g. bathroom, spirit room and storage. Therefore, the living units of Thai houses become highly self-contained and can be easily added to or cut off from the main compounds. Together bedroom-based and veranda-based relations illustrate one of the strongest characteristic features of Thai houses.

Part-whole strategies:

Syntax 4 and 5 are the most certain relations in Thai houses with an average of 3 and 4 spaces in the configurations, respectively. The locations of the syntax in the spatial structure of the buildings are often isolated from most elements. Mean integration values of syntax 4 (0.707) and 5 (0.701) suggest that the syntaxes have a similar impact on the whole. In figure 7.19, syntax 4 and 5 are all in deep parts of houses 1, 2 and 3 while they are located in various parts of the structures in the contemporary houses. These syntaxes are linked with the whole mostly by b-based relations and functionally by parts of the central open space in the selected Thai houses. Syntax 4 and 5 are the most distinct in the design of house 3 where the syntaxes either have the highest mean integration values (0.95) or the highest number of spaces (10) because they directly connect to open spaces with d-or c-based relations. In this way, the syntaxes exploit the dynamic of the highly open-plan design. Most of the spaces in these syntaxes are not connected to passage-type but mostly with junction-type spaces except in house 6 where space is very limited.

Indoor/outdoor strategies:

Syntax 4 and 5 are obviously in indoor spaces due to their functional dimension of being bedroom and bathroom. The interesting design aspect is that the syntaxes are not hidden away through a long string of passage-based relations. The privacy of the syntax is achieved by place-or junction-based relations and the 'partition-less' concept. The connections between indoor and outdoor space in a Thai house are defined three-dimensionally. For example, between the bedroom and the open *chan* space there is a

junction space of veranda where the volume of space is compressed from outdoor scale to about head height (Figure 7.20). In this way, the bedroom-based relations, e.g. syntax 5, 21 and 36, are shielded from abrupt accessibility and the penetrative glimpse of people as they move along the outdoor space on the terrace. This strategy is applied mainly to syntax 5 and bedroom-based syntax since syntax 4, bathroom, is normally located away from the main part of the house or directly connect to only the bedroom syntax in contemporary cases. The strategy is one of the best-kept characteristics of Thai houses.

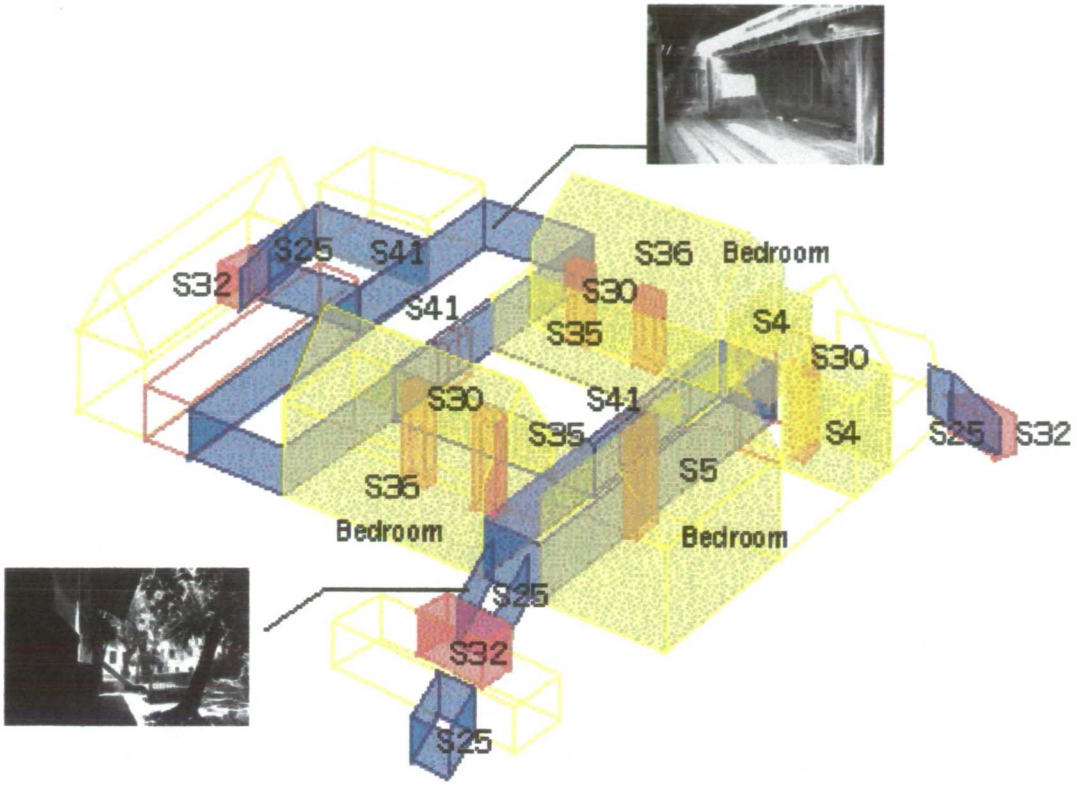


Figure 7.13 Syntax in house 1

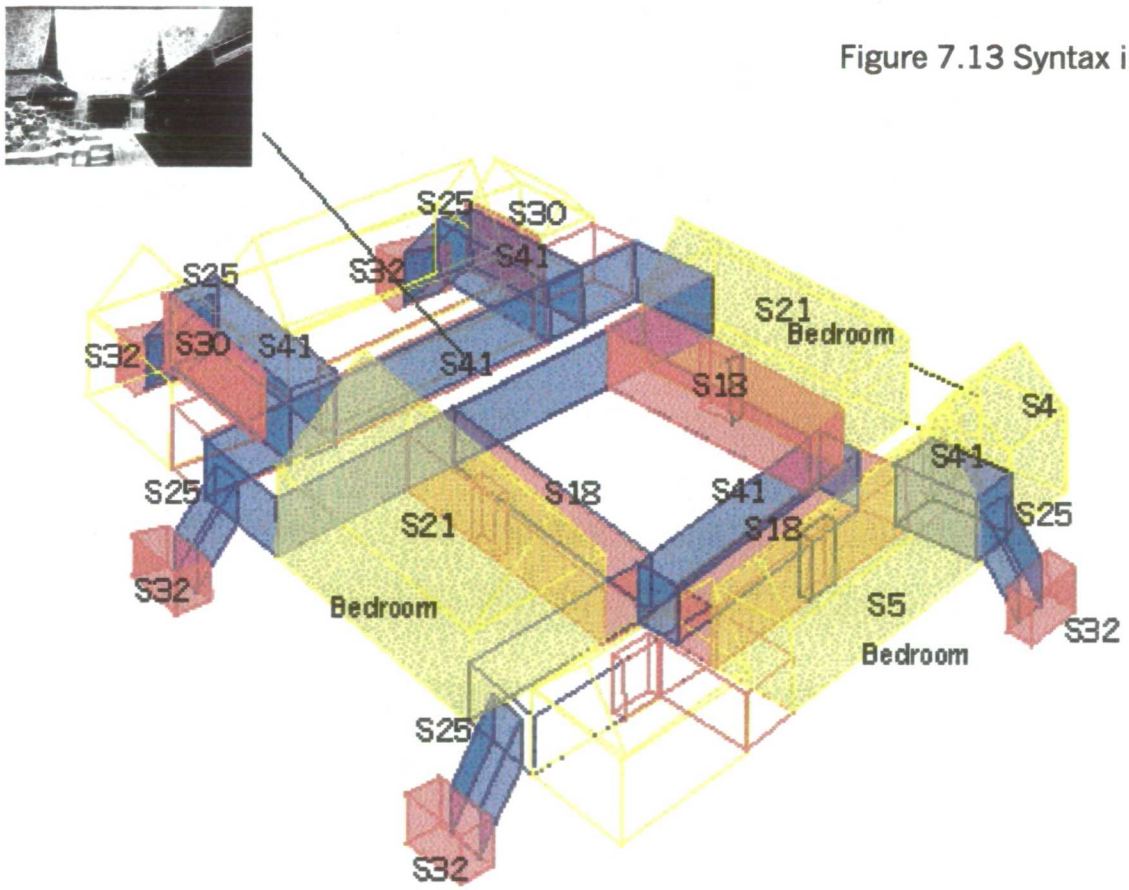


Figure 7.14 Syntax in house 2

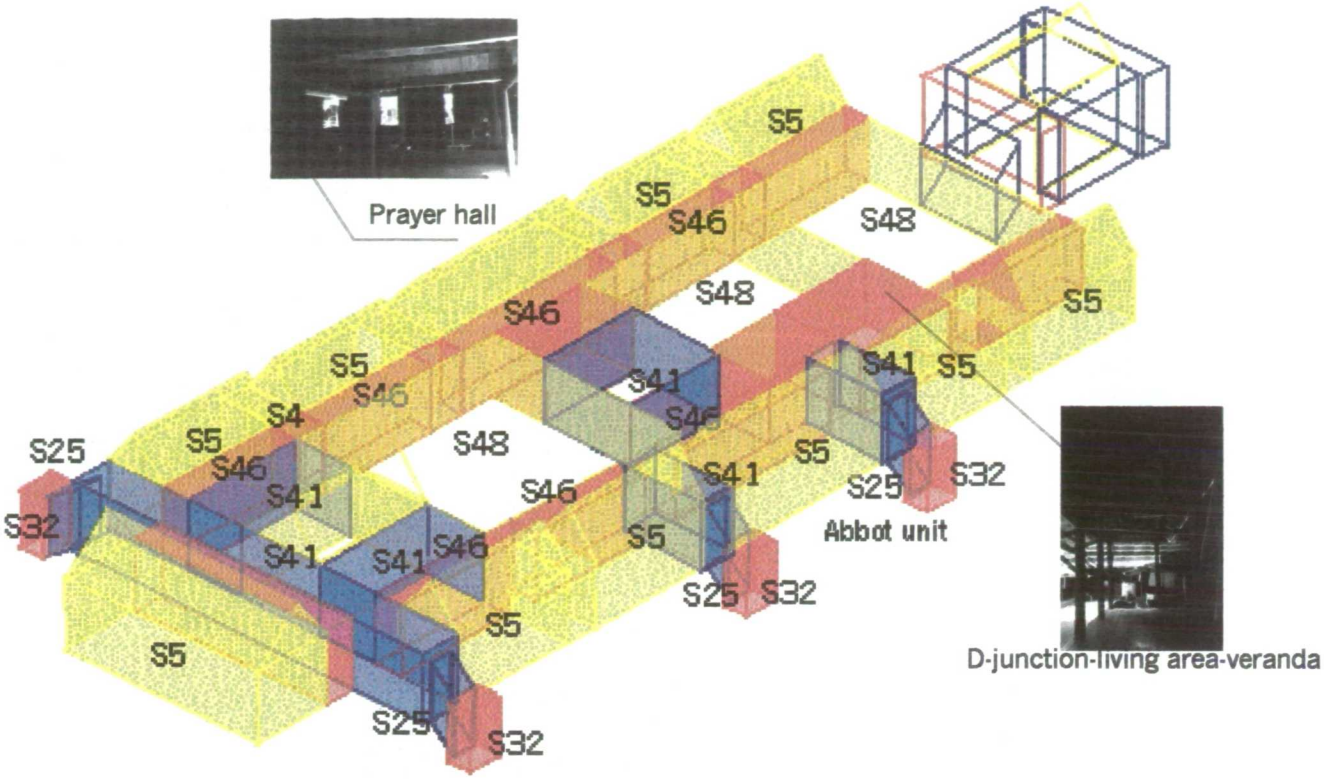


Figure 7.15 Syntax in house 3

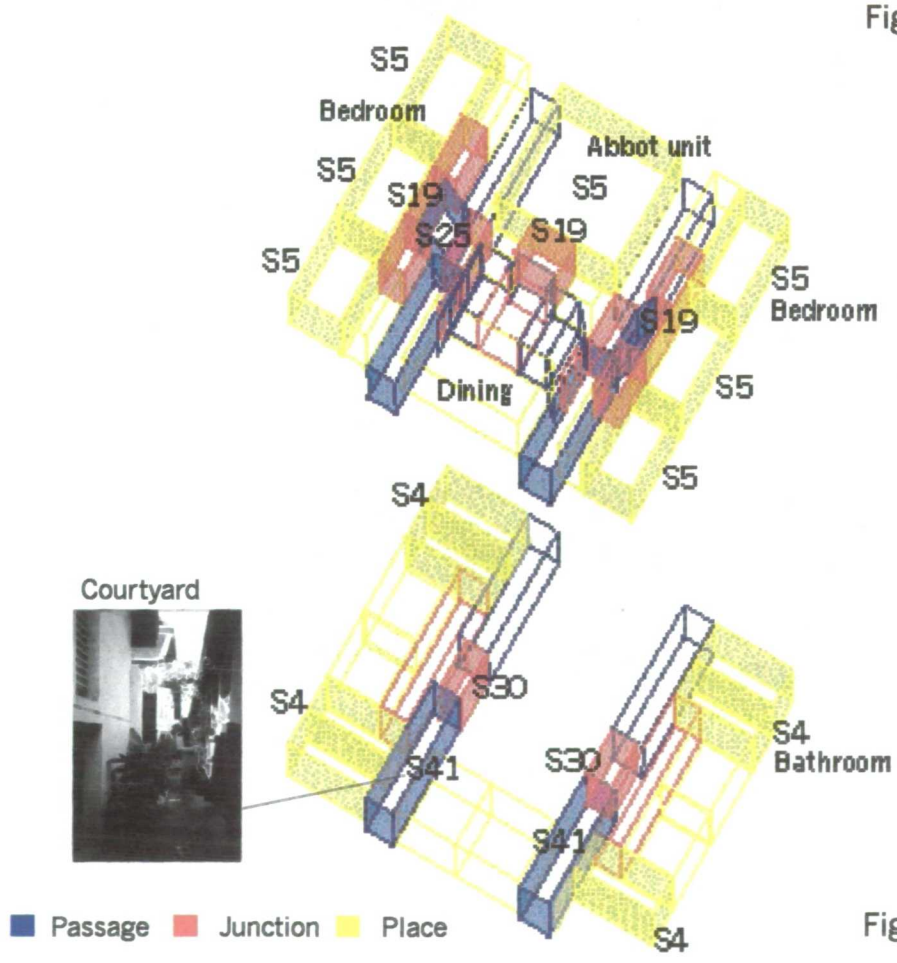


Figure 7.16 Syntax in house 6

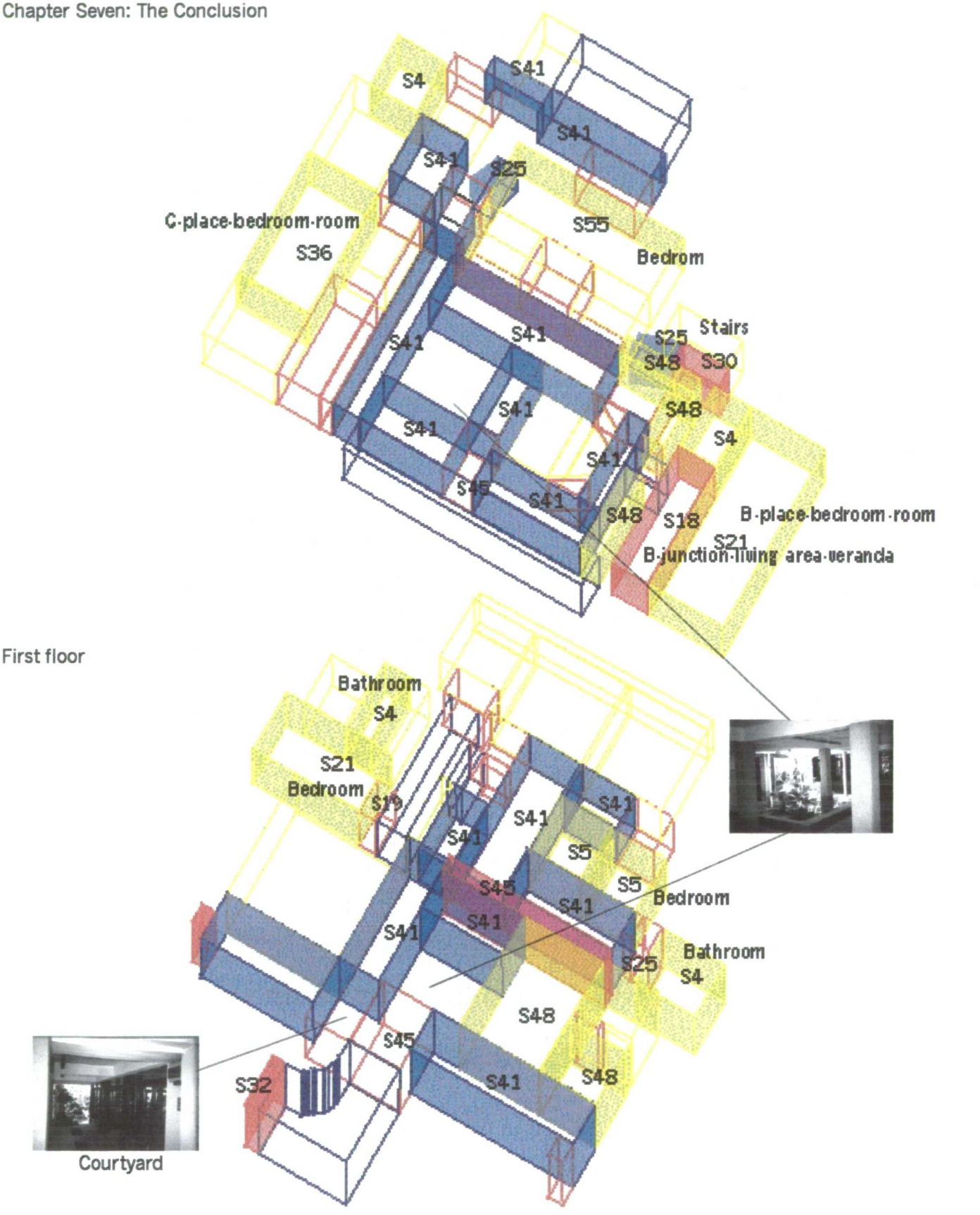


Figure 7.17 Syntax in house 4

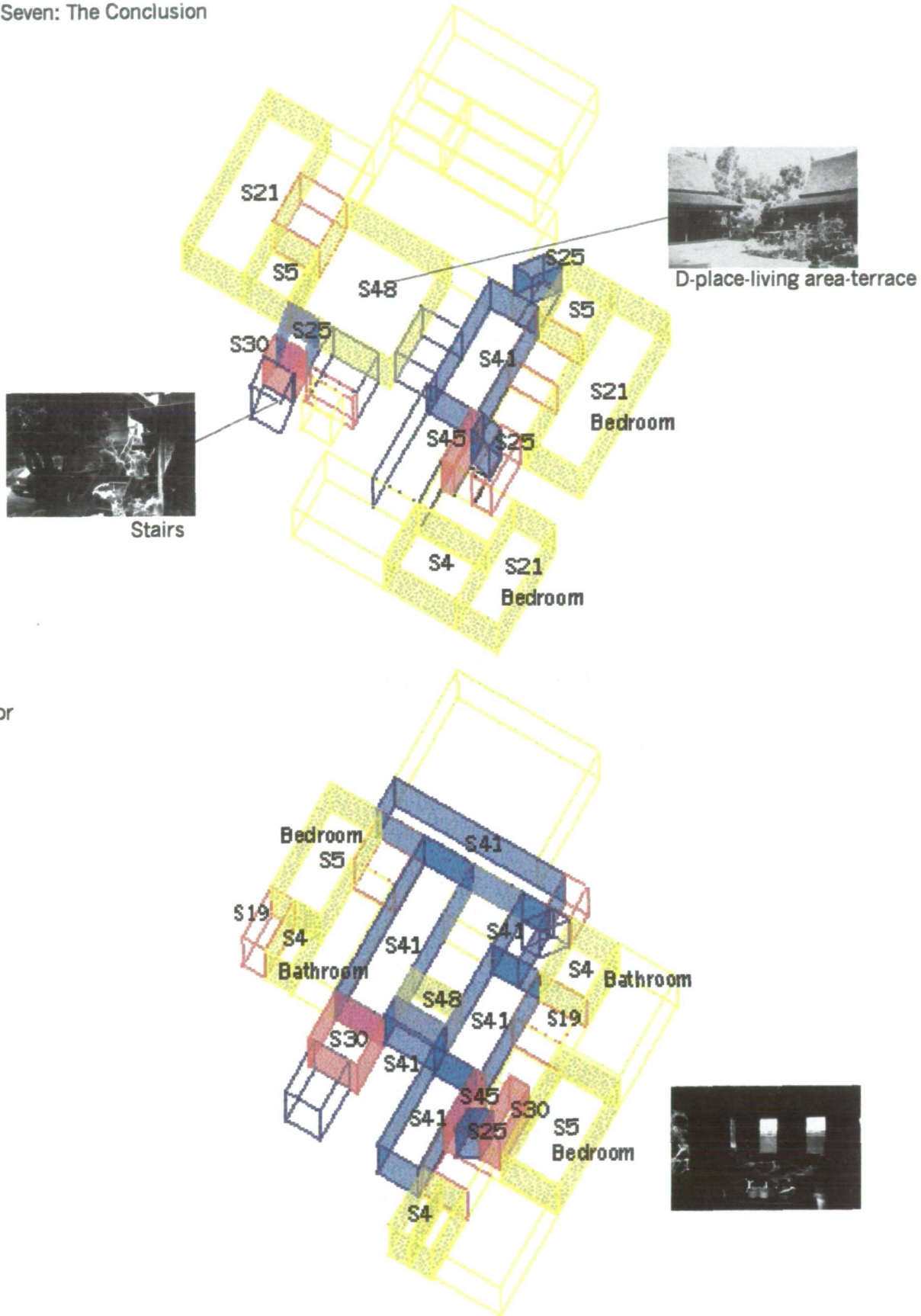


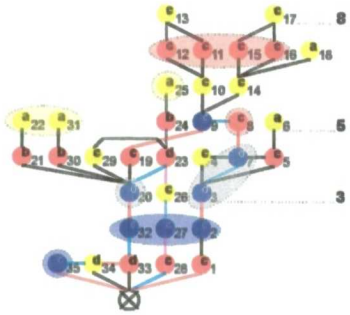
Figure 7.18 Syntax in house 5

Syntax 4 and 5: a-place-bathroom/bedroom-room

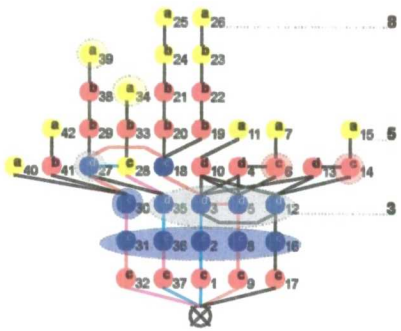
Syntax 25: c-passasge-circulation-stairs

Syntax 30: c-junction-circulation-terrace

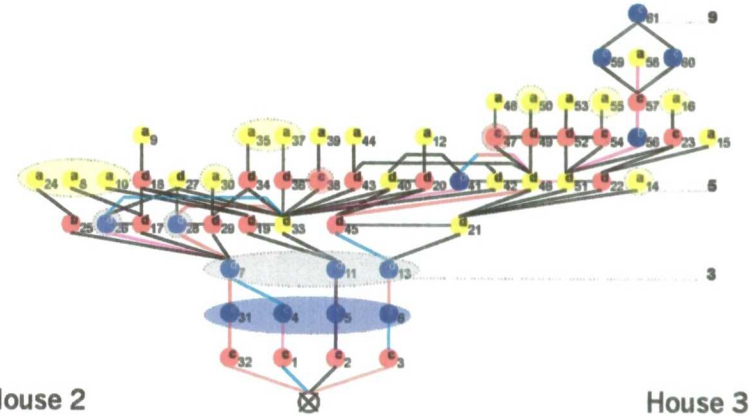
Syntax 41: d-passage-circulation-terrace



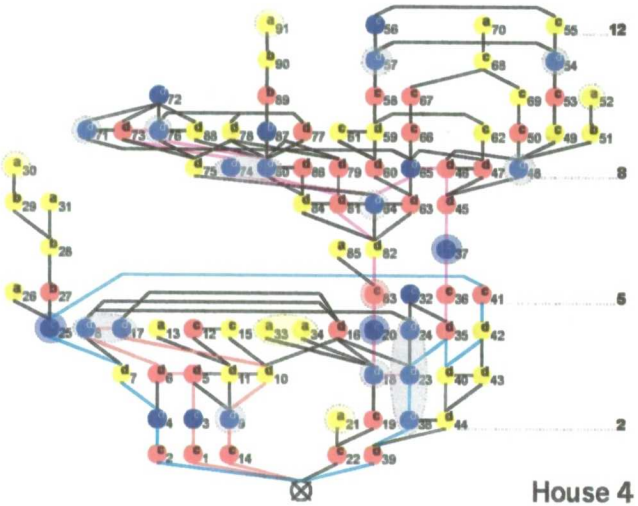
House 1



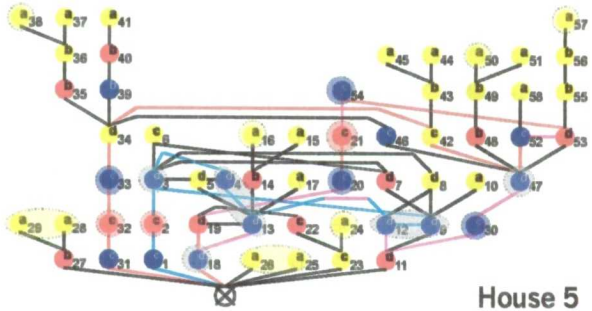
House 2



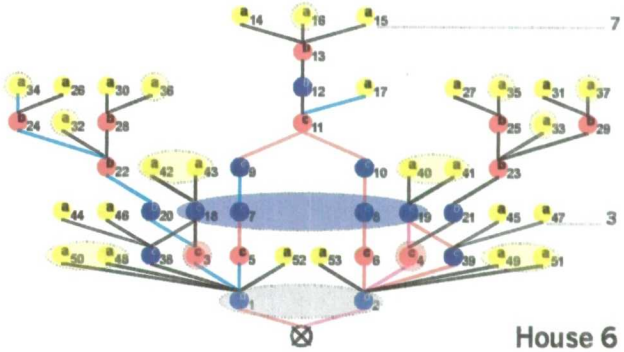
House 3



House 4



House 5



House 6

passage

junction

place

Route 1

Route 2

Route 3

Figure 7.19 Relational syntax in houses 1-6

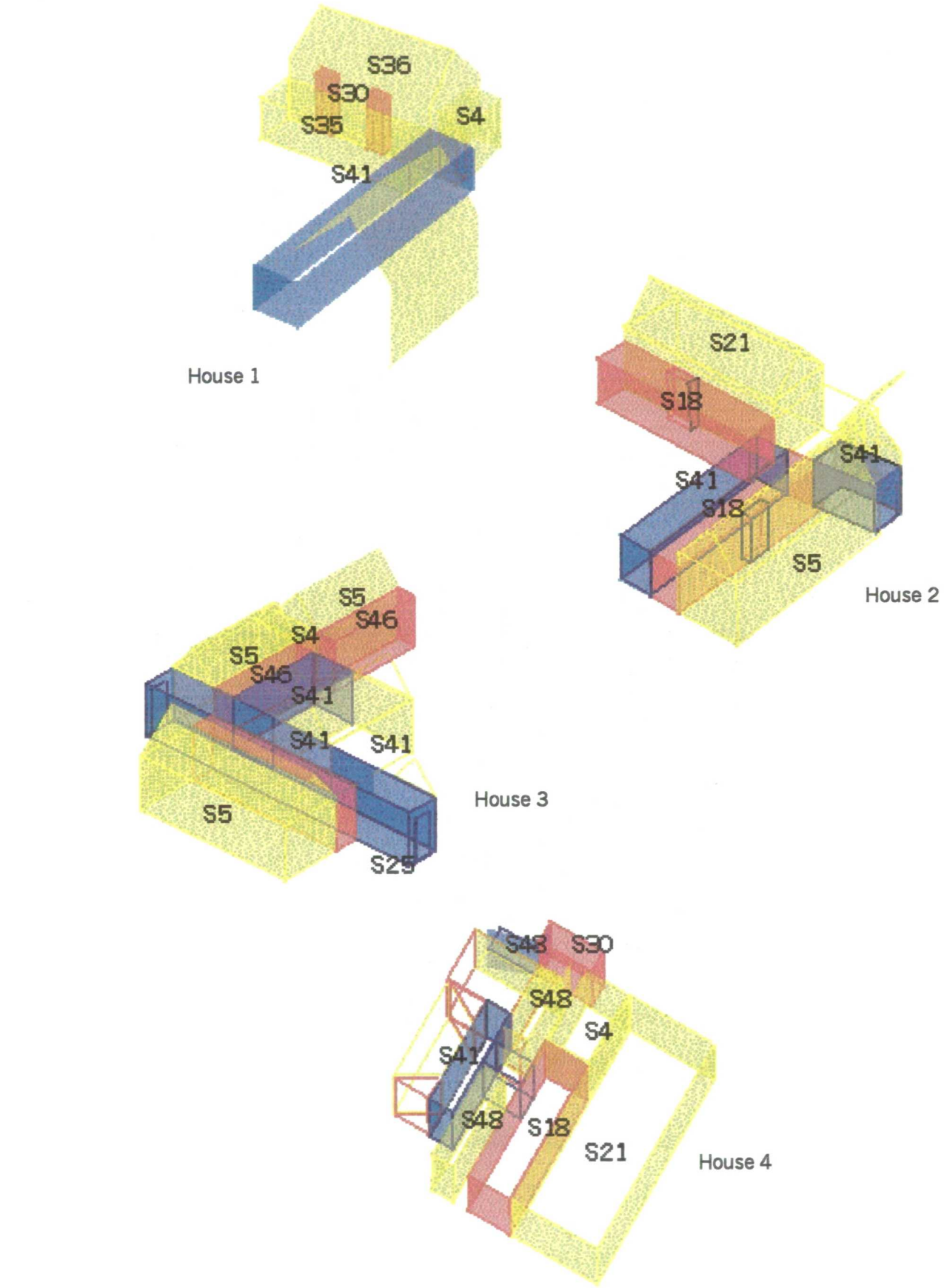


Figure 7.20 Indoor/outdoor strategies in houses

Syntax 25: c-passage-circulation-?

House 1					
c	→passage	→circulation	→stairs	= 4	0.795
			→terrace	= 1	1.242
House 2					
c	→passage	→circulation	→stairs	= 5	0.977
			→terrace	= 1	1.145
House 3					
c	→passage	→circulation	→stairs	= 4	0.954
			→veranda	= 3	0.640
House 4					
c	→passage	→circulation	→courtyard	= 2	0.703
			→stairs	= 2	0.985
			→hallway	= 1	0.691
House 5					
c	→passage	→circulation	→stairs	= 4	1.025
			→terrace	= 2	1.016
House 6					
c	→passage	→circulation	→stairs	= 2	0.799
			→courtyard	= 2	0.778
			→terrace	= 2	0.697

Syntax 30: c-junction-circulation-?

House 1					
c	→junction	→circulation	→doorway	= 6	0.851
House 2					
c	→junction	→circulation	→terrace	= 2	0.863
House 3					
c	→junction	→circulation	→terrace	= 2	1.236
			→veranda	= 1	0.828
House 4					
c	→junction	→circulation	→stairs	= 1	1.040
House 5					
c	→junction	→circulation	→stairs	= 2	0.947
			→courtyard	= 1	0.855
House 6					
c	→junction	→circulation	→courtyard	= 2	0.956
			→terrace	= 1	0.714

Table 7.3.2 Relational syntax 25 and 30 in houses 1-6

Socio-cultural strategies:

Each of these two c-based relational syntax has five different architectural elements. The dominant relation in syntax 25 is c-passage-circulation-stairs (21 spaces). The domination of stairs space in this syntax is expectable in Thai houses since the whole house is raised on a platform connected to the ground via external stairs. In large houses such as houses 2 and 3, there are 5 and 4 stairs that provide direct access to different parts of the houses (Figures 7.14-7.15). In this way, Thai houses create different zones that are highly independent even though they share the same common *chan* space. As shown in route analysis (section 6.3), the stairs syntax at the front is used only by the owner and guests while servants are only allowed to used the back and service stairs.

This effect is less obvious in contemporary houses 4 and 5 where stairs connect two floors rather than the houses and exterior space (Figures 7.17-7.18). Service stairs are still mainly used by servants but are not as secluded as in conventional houses. Syntax 25 and 30 in houses 4 and 5 are created using similar design strategies that have the back and service stairs integrate the extension parts of the houses. The service sectors of these houses are secluded by the area where only through movement takes place. This strategy has been used in conventional houses on a larger scale between the whole houses and the outside. The syntax increasingly becomes a symbolic feature very much preserved in contemporary Thai houses. House 6 uses c-passage-circulation-stairs to provide privacy for the monk units from the main passages leading to the exterior space (Figure 7.16). In five houses, syntax 25 is attached with syntax 32, c-junction-entrance-stairs which is in a small platform before the stairs. Syntax 32 indicates the first point where one enters the house with only a small change of level and bodily movement as in syntax 18, b-junction-living area-veranda, between the open space and bedrooms. In this way, Thai houses communicate its quality through sections more than plans.

Syntax 30 of c-junction-circulation-terrace also closely associates with syntax 25, as they work together to create levels in stairs and other parts of the house. This junction-based syntax is briefly involved with one's movement and may seem insignificant in the first instance but it is the point where the idea of the house or a different space is firstly presented. Syntax 30 is realised as terrace five times in three houses and it is often in small spaces that are parts of various architectural elements. The syntax's weakness in concentrating on certain elements can be seen as a strong point in terms of flexibility in Thai designs. The syntax is often in space that connects many functions or where the stairs are connected to the upper or lower floor of the houses.

Part-whole strategies:

The majority of spaces in syntax 25 are realised as c-passage-circulation-stairs in all selected Thai houses (Table 7.3.2). It is very clearly grouped in the justified graphs of houses 1, 2, 3 and 6. In houses 4 and 5, the syntax is in highly strategic locations connecting groups of different structures (Figure 7.19). The relation has the highest number of spaces in house 2 (bold numbers indicate the highest number of spaces in that house) while it is dominant in other houses. c-passage-circulation-stairs clearly controls

all the structure in conventional houses having high integration values (0.914) and number of spaces (13). In houses 4 and 5 it has the most integrated effect (1.011) despite its smallest proportion of the space (6). The syntax is mostly connected with c-junction-based syntax such as syntax 32: c-junction-entrance-stairs in conventional houses.

Syntax 30 and 32 depend on syntax 25 in order to be parts of the structure with the exceptions in houses 1 and 3. Syntax 30 in house 1, c-junction-circulation-doorway, has no relation with syntax 25, c-passage-circulation-stairs. However, the syntax works in a similar way to syntax 25 in the structure of house 1 but on a smaller scale when it controls the inner part, bedroom, instead of the whole house as in syntax 25. In house 3, syntax 30 is in spaces of the terrace that control the access to storage space. As a whole, syntax 30 has a weak architectural identity but has strong control effects in local scale while syntax 32 is very much a part of syntax 25 when it is realised into c-junction-entrance-stairs. Many spaces of syntax 25, 30 and 32 involve the three most used routes (section 6.3) indicating that they are typical parts of the houses' structures (Figure 7.19).

Indoor/ outdoor strategies:

As parts of stairs in Thai houses, syntax 25, 30 and 32 are all parts of outdoor space which is often regarded as an extension of the indoor space in conventional design (Figure 7.21). Even though these syntaxes are in open spaces, the design treats them as space of the house while exterior space beyond syntax 32: c-junction-entrance-gateway is treated as the real outdoor space. Syntax 30 in house 2 is in spaces between the terrace and the partially enclosed pavilions (Figure 7.14). This concept is similar to the veranda spaces in front of the bedrooms (e.g. syntax 18 in figure 7.14) but a smaller degree of privacy in pavilions has influenced smaller junction-based spaces for a smoother transition between open terrace space and pavilions. In this way, syntax 30 tends to be located deeper into the house while syntax 32 and 25 are often in the space 'inside' the house that are located 'outside' the main living area.

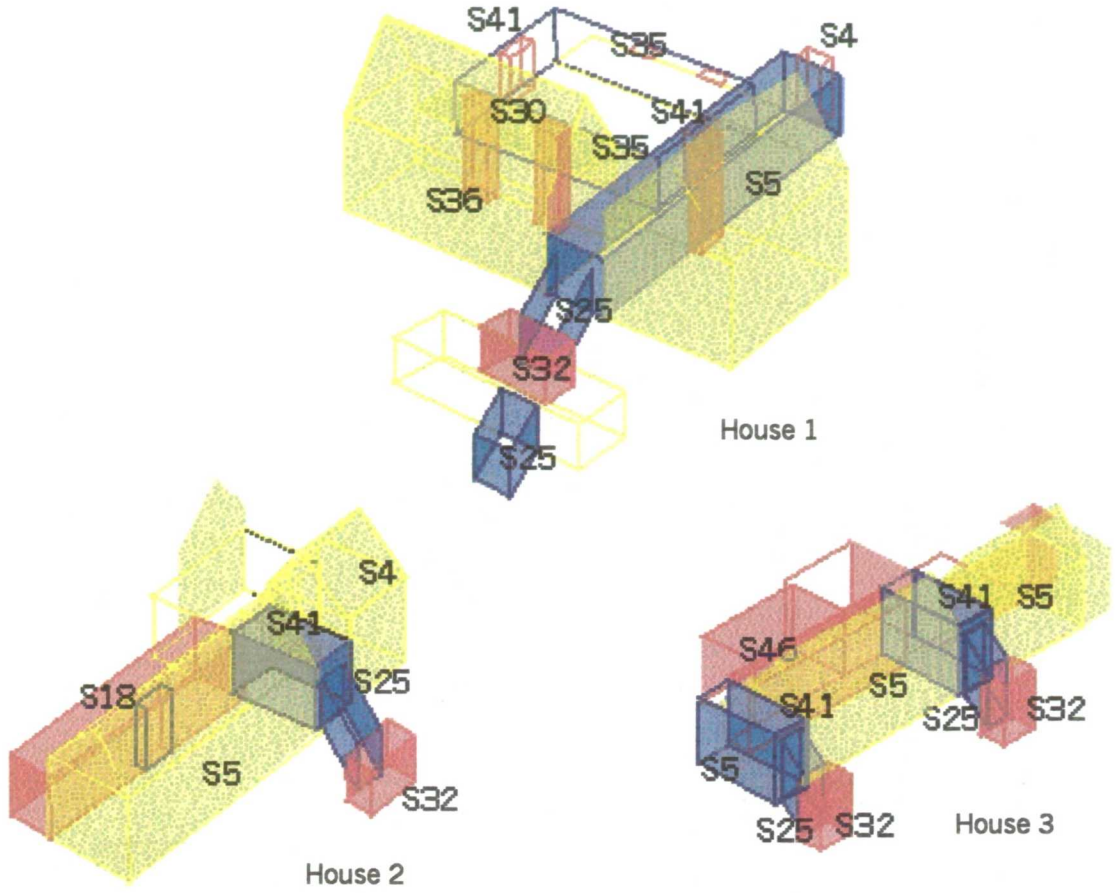
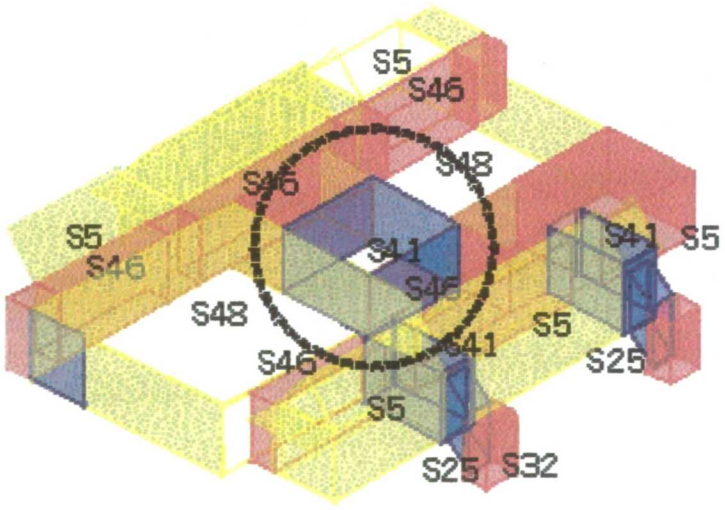


Figure 7.21 Stairs and platforms in houses



Passage Junction Place

Figure 7.22 Syntax 42 in house 3

Syntax 41: d-passage-circulation-?

House 1					
d	**→passage**	**→circulation**	**→terrace**	**= 3**	**0.996**
House 2					
d	**→passage**	**→circulation**	**→terrace**	**= 5**	**0.977**
House 3					
d	**→passage**	**→circulation**	**→terrace**	**= 6**	**1.339**
House 4					
d	**→passage**	**→circulation**	**→terrace**	**= 10**	**0.766**
			→courtyard	**= 7**	**0.890**
			→room	**= 1**	**0.677**
House 5					
d	**→passage**	**→circulation**	**→courtyard**	**= 6**	**0.999**
			→terrace	**= 1**	**1.288**
House 6					
d	**→passage**	**→circulation**	**→courtyard**	**= 2**	**1.129**

Table 7.3.3 Relational syntax 41 of houses 1-6

Socio-cultural strategies:

The majority of relations in syntax 41 strongly evolve into terraces in five houses. In fact, d-passage-circulation-terrace is the only relation of syntax 41 in the conventional Thai houses while there are two other relations in contemporary houses. Houses 5 and 6 relate this syntax more with courtyard influenced by simplicity in house 5 and compactness in house 6 (Figures 7.16&7.18). However, terrace and courtyard are often the reflection of each other in a two-storey Thai house. This syntax defines the open-plan and highly flexible organisation of living units on one platform of Thai house. d-passage-circulation-terrace creates a dynamic whole that can be easily extended, modified, separated and even reassembled. Globally, syntax 41 is the most important in structure and experience of a Thai house.

Syntax 41 contains the richest experience of a Thai house; it is often created in very important spaces to define different zones. Syntax 41 divides houses 1 and 2 into three parts while sharing one *chan* space (Figures 7.13-7.14). These spaces are differentiated by social requirements; that is, the front parts of houses 1and 2 are controlled by a large open terrace space dealing with the large volume of movement during special events. The middle part provides buffer zones for the inner parts of the houses while in the back part the syntax controls service activities. In this way, syntax 41 provides both connections and retains zonings; this 'partition-less' effect is one of the strongest characters of Thai houses where circulation spaces are strategically located to achieve different areas.

Syntax 41 in the space at the centre of house 3 is also the centre point for religious activities (Figure 7.15). This passage space connects as well as divides the living zone from the religious zone. The mechanism of syntax 41 in Thai houses is closely related with socio-cultural codes of behaviour; that is, as a passage the syntax is in *chan* space from where one can get a glimpse of other areas but can not 'be' there without making a real effort. Syntax 41 in house 4 is in much more fragmented spaces since the concept of one common space is much weaker than in the conventional designs. The syntax is realised into courtyard-based syntax on the ground floors of houses 4 and 5. d-passage-circulation-terrace in contemporary Thai houses tends to be more complex and 'corridor' like rather than straightforward and open. Houses 5 and 6 have only a few terrace-based syntaxes because terrace is very much the extension of the living units in house 5 while house 6 design stresses a secluded lifestyle.

Part-whole strategies:

Syntax 41 is heavily involved with all of the three important routes in all six houses (Figure 7.19). The syntax has a very high mean integration values (0.994) and the largest number of spaces (25) of all the syntaxes. Spaces of this syntax are often in very strategic locations in the structures controlling the whole configurations by participating in the main circulation of movement in the houses. d-passage-circulation-terrace delivers movement that often come from c-passage-circulation-stairs to all parts of the house. Houses 2, 3 and 6 have very powerful spaces of syntax 41, the highest number of space in house 2 and the highest integrated space in house 3. The syntax gains full control of the whole configuration in houses 3 and 6 as it is in the spaces that are the origin of all structures in the houses.

Syntax 41 is often linked with syntax 45, d-junction-circulation-terrace, especially when it is in spaces of complex structures such as houses 3 and 4. House 4 has the highest number of spaces with syntax 41 (10 on terrace and 7 spaces in courtyard) which seems to indicate the high degree of complexity in its structure. The syntax is often in spaces that are in or close to the most complex parts of the structure in all selected Thai houses (Figure 7.19) except house 6. The locations of syntax 41 in the structure of contemporary houses 4 and 5 are more diverse than in the selected conventional houses which have similar design strategies. The sequence starts from the root to syntax 32, c-junction-

entrance-stairs, moving to syntax 25, c-passage-circulation-stairs, towards syntax 41, d-passage-circulation-terrace, and finally to the rest of the houses.

Indoor/outdoor strategies:

d-passage-circulation-terrace is the major syntax created in the outdoor space which shapes the whole Thai houses. Syntax 41 is never directly linked with indoor space such as syntax 4 or 5 but to supply all indoor units with connections to the rest of the house. The syntax has concept of openness that is the most contrast to indoor space making the structure as a whole very dynamic when the two are located next to each other. In Thai houses, the indoor space is very simple and usually faces the outdoor space of *chan* space. In this way, bedroom-based and terrace-based syntax can be very accessible from both ends; that is, the indoor spaces can be tuned into parts of the big outdoor space as easily as parts or all of the outdoor space can be turned into one big room. This design strategy has been employed in most Thai houses where spaces of syntax 41 occasionally expand into indoor spaces such as space 41 at the centre of house 3 expands into the prayer hall next to it creating a large room when needed (Figure 7.22).

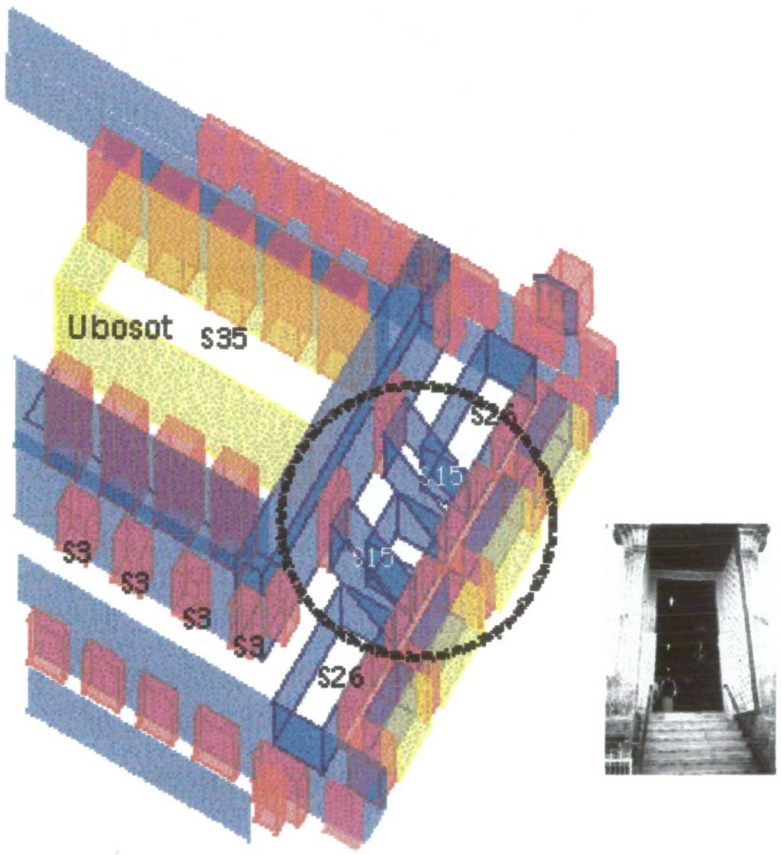
Other interesting syntaxes in the selected Thai house spaces are syntax 35 and 48: c-place-living area-terrace and d-place-living area-terrace representing one of the best known characteristics of Thai houses where spending time outside rooms strongly defines the architecture. Syntax 21: b-place-bedroom-room is increasingly used in the living units of contemporary houses where rooms are equipped with facilities such as bathroom and dressing room. Syntax 19: b-junction-foyer-veranda or -room is the new syntax available only in contemporary houses where verandas are no longer parts of *chan* space. There are many new syntaxes in the selected contemporary houses that are derived from new functions, e.g. study room, foyer etc. As a result, 27 syntaxes, out of 53, appear only in one house (Table 7.3) which suggests that Thai houses and perhaps houses in general have highly individualistic design strategies. The final consideration will be on the idea of genotype syntax of Thai houses in comparison to Thai temples. Before that we shall look at the selected Thai temples in the same way as we did in houses.

Temples 1-6 (all relational syntaxes in table 7.4, appendix)

42 relational syntaxes are created in 2369 spaces of the selected Thai temples. Syntax 15 (c-passage-circulation-stairs), 16 (c-junction-circulation-cloister or -terrace), 26 (d-passage-circulation-terrace), 31 (d-junction-circulation-terrace) and 35 (d-place-prayer hall-hall) appear in all temples. There are three other interesting syntaxes that appear in five temples: syntax 3 (a-junction-orientation-window), syntax 17 (c-junction-entrance-gateway) and syntax 36 (d-place-prayer space-terrace). All these three syntaxes are highly symbolic but they do not appear in all temples which seems to suggest that the design strategies in Thai temples are dynamic despite the strict religious rules. Syntax 35, will be discussed with syntax 3 since they are both parts of the *ubosot*. Syntax 17 and 36 will be discussed with c-based syntax 15 and 16 and d-based syntax 26, respectively while other syntaxes will be looked at in relation to these syntaxes. Similar to houses, the following discussion will examine these syntaxes based on socio-cultural, part-whole and indoor/outdoor strategies.

Socio-cultural strategies:

Syntax 15 is realised in six different relations with the most common c-passage-circulation-stairs relation (105 spaces). However, more spaces are realised as terrace than as stairs in temples 4 and 5. Terrace-based relations usually dominate many parts of a temple dealing with a much larger scale of space than stairs-based relations which has stronger effect closer to the centre of the temple. For example, stairs that lead into the prayer hall are specially designed with syntax 17 (c-junction-entrance-gateway) to create an effect of virtual segregation between activities inside and outside the *ubosot*. Stairs in Thai temples are often seen as the representation of one's efforts to reach a better self by praying inside the *ubosot* therefore the syntax creates differences between 'better' self in religious area and ordinary people outside. The concept is very distinctive in conventional designs such as in temples 1 and 2 where there are up to eight sets of syntax 15 in key locations around the *ubosots*. One has to go through these stair systems which are intentionally placed 'away' from the sacred core where there usually are distinctive design of long and steep stairs for syntax 15 (Figure 7.23).



Passage Junction Place

Figure 7.23 Syntax 15 in temple 1

Syntax 15: c-passage-circulation-?

Temple 1					
c	→passage	→circulation	→stairs	= 12	0.773
			→courtyard	= 12	0.585
			→cloister	= 8	0.776
			→terrace	= 2	0.598
			→hallway	= 1	0.492
Temple 2					
c	→passage	→circulation	→stairs	= 48	0.556
			→terrace	= 38	0.591
			→courtyard	= 25	0.700
			→pavilion	= 6	0.572
Temple 3					
c	→passage	→circulation	→cloister	= 15	0.681
			→stairs	= 14	0.615
			→hallway	= 1	0.607
			→courtyard	= 2	0.564
Temple 4					
c	→passage	→circulation	→terrace	= 19	0.647
			→stairs	= 9	0.771
			→courtyard	= 1	0.496
Temple 5					
c	→passage	→circulation	→terrace	= 23	0.705
			→stairs	= 15	0.712
			→hallway	= 2	0.521
Temple 6					
c	→passage	→circulation	→stairs	= 7	0.708
			→terrace	= 1	0.688

Syntax 16: c-junction-circulation-?

Temple 1					
c	→junction	→circulation	→cloister	= 236	0.835
			→terrace	= 47	0.903
			→doorway	= 36	0.720
			→hallway	= 4	0.460
Temple 2					
c	→junction	→circulation	→cloister	= 210	0.676
			→doorway	= 67	0.480
			→terrace	= 51	0.534
			→courtyard	= 17	0.652
			→pavilion	= 2	0.717
			→hallway	= 2	0.398
Temple 3					
c	→junction	→circulation	→cloister	= 21	0.716
			→terrace	= 13	0.784
			→hallway	= 5	0.560
			→doorway	= 4	0.666
			→courtyard	= 4	0.534
Temple 4					
c	→junction	→circulation	→terrace	= 35	0.729
			→stairs	= 3	0.677
			→courtyard	= 2	0.555
Temple 5					
c	→junction	→circulation	→terrace	= 18	0.789
			→stairs	= 5	0.542
			→doorway	= 2	0.596
Temple 6					
c	→junction	→circulation	→doorway	= 3	0.712
			→stairs	= 2	0.578
			→terrace	= 1	0.690

Table 7.4.1 Relational syntax 15 and 16 of temples 1-6

Contemporary Thai temples use syntax 15 in a less distinctive way; that is, stairs are not specially treated to create the effect of 'sacred' passage. The syntax becomes much less significant in its architectural reality; many new temples have discarded the traditional effect by designing open and direct stairs to the *ubosot* (Figure 7.24). Syntax 16, dominated by the c-junction-circulation-cloister relation, is only used in the conventional temples while it is most often realised as c-junction-circulation-terrace in contemporary temples. In conventional Thai temples, cloister space does not make up the largest area of space but it is the most extensive in the experience. Cloisters of syntax 15 emphasise the *ubosots* by being the place where one can observe the building from all directions while terrace-based syntax 16 draws people towards the centre not around it.

Part-whole Strategies:

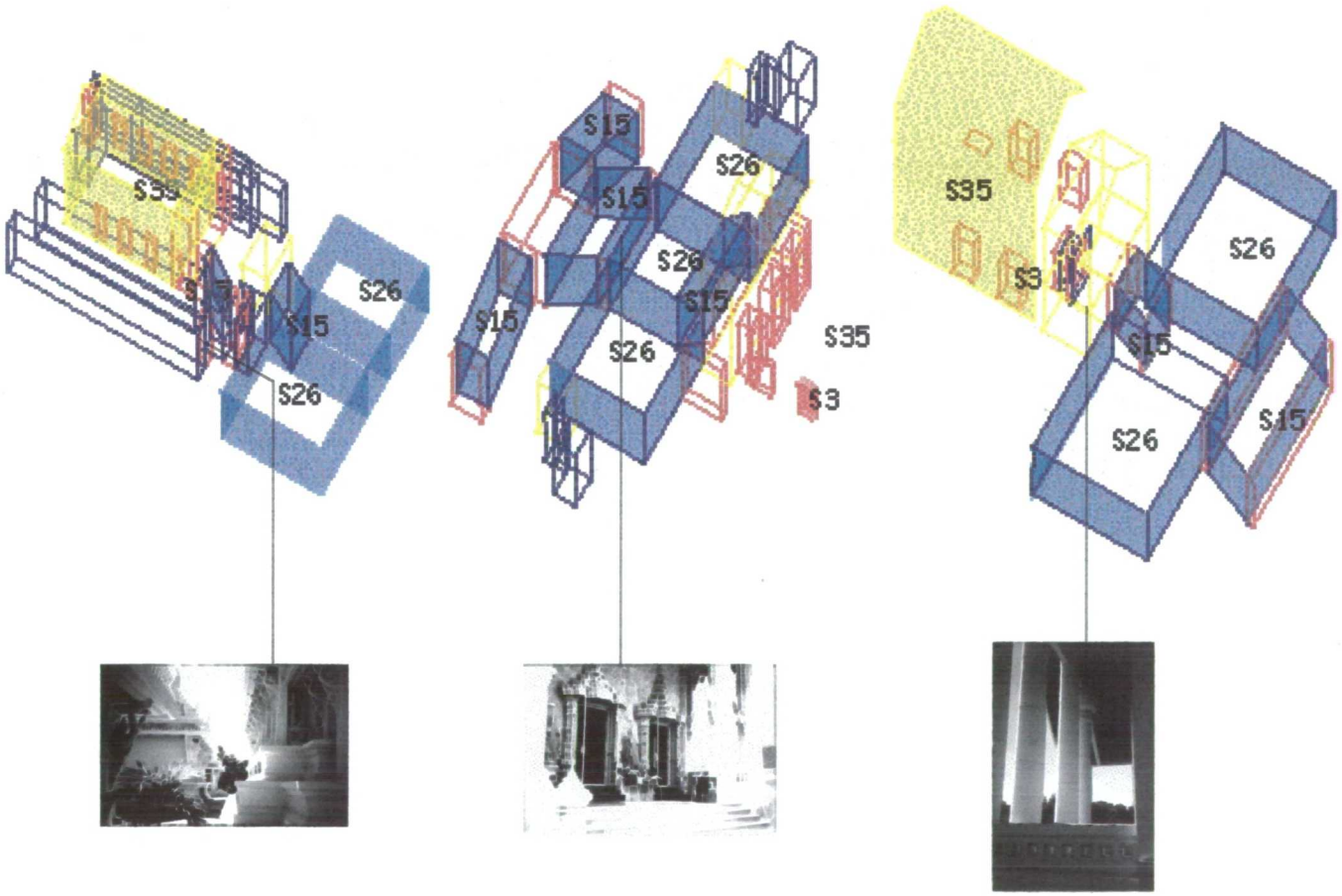
Syntax 15 and 16 in conventional designs are both used for segregation effect. The mean integration value of syntax 15 in the contemporary Thai temples (0.730) is higher than in conventional temples (0.648). Furthermore, fewer spaces are needed for syntax 15 in contemporary temples suggesting a more straightforward design strategy. However, in reality the experiences in these contemporary temples are fragmented because the temples focus heavily on specific parts such as the front entrance often leaving other parts deserted. Conventional temples often distribute many types of syntax in various locations therefore their configurations tend to have a more unified experience. Syntax 16 in general has a larger effect than syntax 15 because it is in the most expansive part of the structure, especially in temples 1 and 2's cloisters. Syntax 15 usually has a local scale effect but in the most important part of the temple related to the *ubosots* sub-complex (Figure 7.33). In six temples, temple 1 has the highest mean integration value in its stairs-based syntax 15 (0.773).

Indoor/outdoor strategies:

The design of syntax 15: c-passage-circulation-stairs creates a powerful connection between inside and outside of the *ubosots* space while in Thai houses it connects the whole house and the exterior. In conventional designs, the transition is strongly defined using syntax 15 and 16 (Figure 7.25). Syntax 15 is used with the designs firstly by having many sets of stairs between zones which are often related to the locations of syntax 17, c-junction-entrance-gateway. In this way, stairs and gateway seem to be physical elements

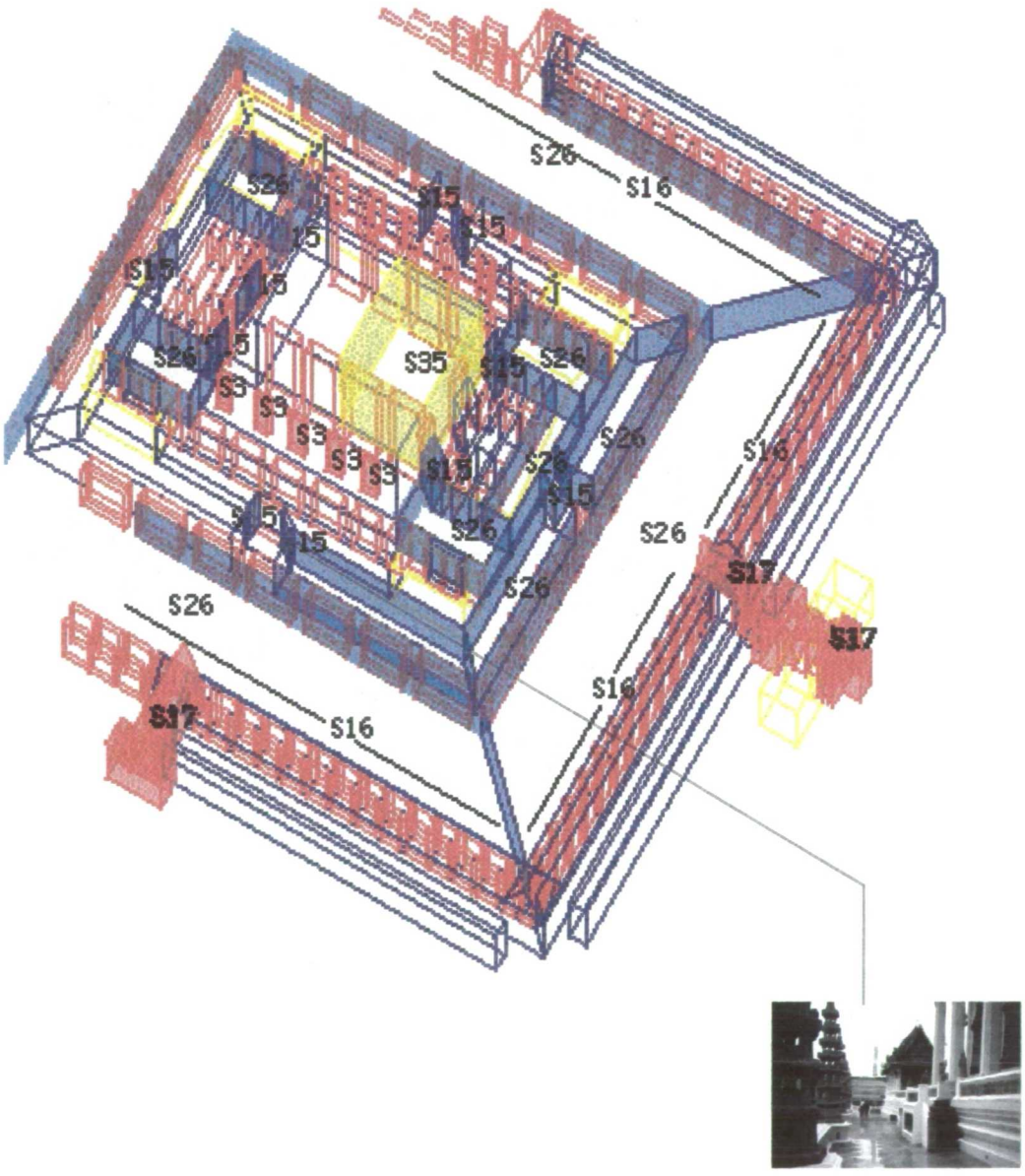
that raise socio-cultural awareness indicating the inside and outside space of Thai temples. The indoor space of the *ubosot* is normally raised to about eye level which is similar to the multi-level concept used to define different spaces without erecting walls in Thai houses.

c-passage -circulation-cloister (syntax 15) and c-junction-circulation-cloister (syntax 16) are used to separate many conventional Thai temples from the exterior space such as in temple 3 (Figure 7.26). However, there is no strong separation between building and exterior space in contemporary temples where syntax 15 and 16 are mainly realised as c-passage-circulation-terrace and c-junction-circulation-terrace, respectively. Syntax 16 is often in small connections on terrace space and often used to define the whole area of temples rather than just the interior space in conventional temples. It seems that terrace- and stairs-based syntaxes are used as substitute strategies in defining the religious area when contemporary temples decide to discard the cloister relation in syntax 16. In short, the indoor and outdoor spaces in new temples are enforced by syntax 15 (c-passage-circulation-terrace or -stairs) on a global scale. Syntax 16 (c-junction-circulation-terrace) and 17 (c-junction-entrance-gateway) are in detail treatments of the buildings such as in temples 4 and 5 (Figure 7.27).



Passage Junction Place

Figure 7.24 Syntax 15 in temples 4, 5 and 6



Passage Junction Place

Figure 7.25 Syntax 15 and 16 in temple 2

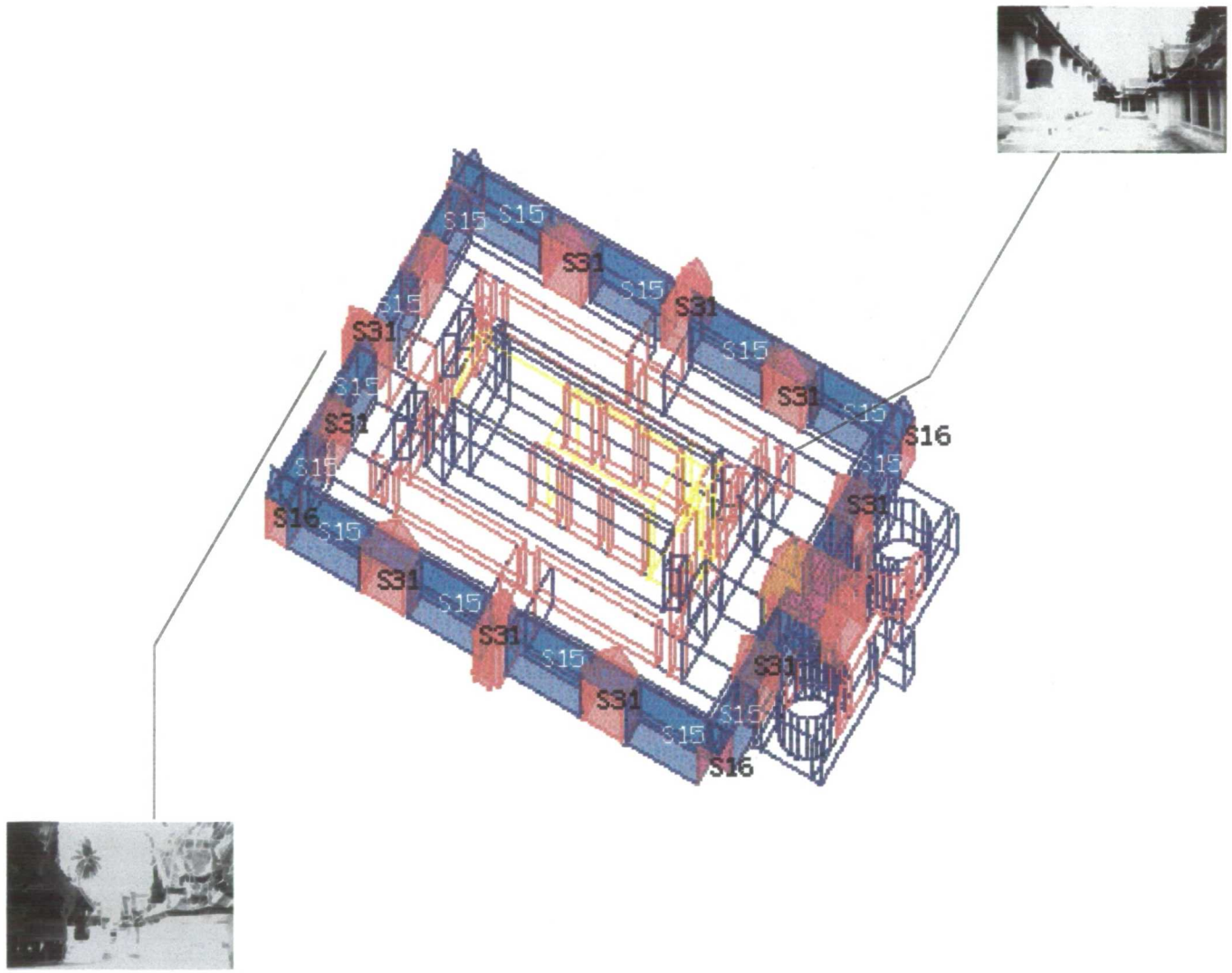
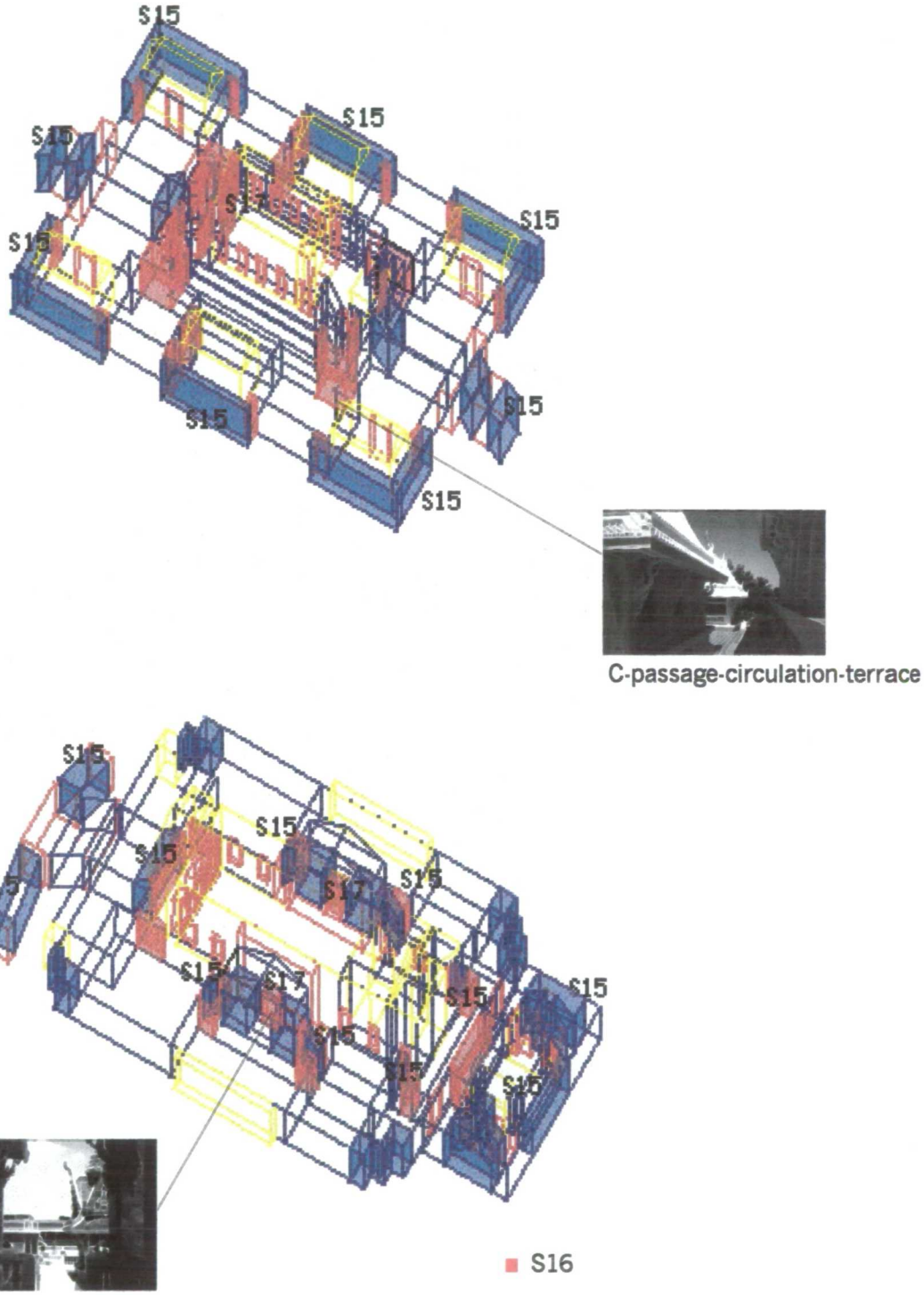


Figure 7.26 Cloister-based syntax in temple 3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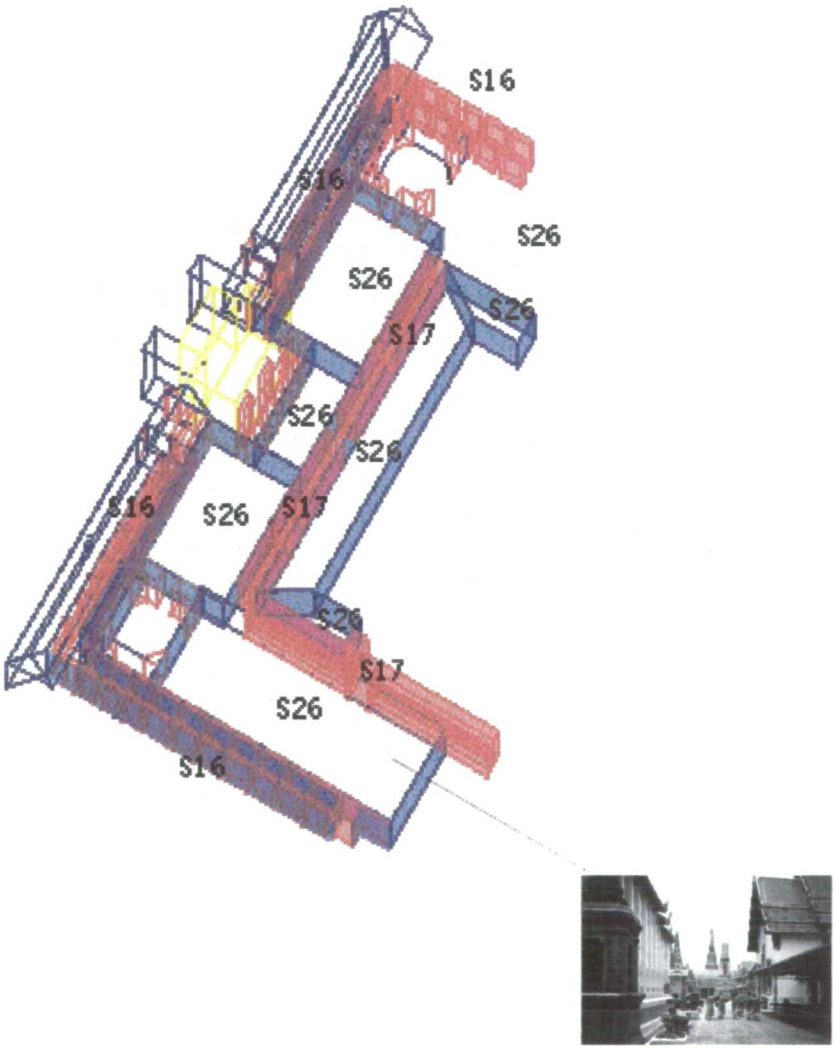


Passage Junction Place

Figure 7.28 Syntax 16, 17 and 26 of temple 1

Syntax 26: d-passage-circulation-?

Temple 1					
d	→passage	→circulation	→cloister	= 48	0.860
			→terrace	= 39	0.892
			→courtyard	= 32	0.790
			→room	= 16	0.732
			→hallway	= 3	0.514
Temple 2					
d	→passage	→circulation	→terrace	= 37	0.581
			→courtyard	= 17	0.768
			→cloister	= 16	0.699
			→hallway	= 3	0.411
Temple 3					
d	→passage	→circulation	→terrace	= 9	0.920
			→courtyard	= 6	0.613
			→hallway	= 2	0.633
Temple 4					
d	→passage	→circulation	→terrace	= 18	0.843
			→courtyard	= 2	0.555
Temple 5					
d	→passage	→circulation	→terrace	= 26	0.783
Temple 6					
d	→passage	→circulation	→terrace	= 10	0.765

Syntax 31: d-junction-circulation-?

Temple 1					
d	→junction	→circulation	→cloister	= 36	0.930
			→terrace	= 34	0.848
Temple 2					
d	→junction	→circulation	→terrace	= 26	0.608
			→courtyard	= 20	0.711
			→cloister	= 8	0.710
			→doorway	= 2	0.431
			→hallway	= 2	0.410
Temple 3					
d	→junction	→circulation	→cloister	= 8	0.846
			→terrace	= 2	0.843
			→courtyard	= 1	0.731
Temple 4					
d	→junction	→circulation	→terrace	= 8	0.817
			→courtyard	= 1	0.630
Temple 5					
d	→junction	→circulation	→terrace	= 5	0.568
			→stairs	= 2	0.675
Temple 6					
d	→junction	→circulation	→terrace	= 8	0.721
			→stairs	= 1	0.743

Table 7.4.2 Relational syntax 26 and 31 of temples 1-6

Socio-cultural strategies:

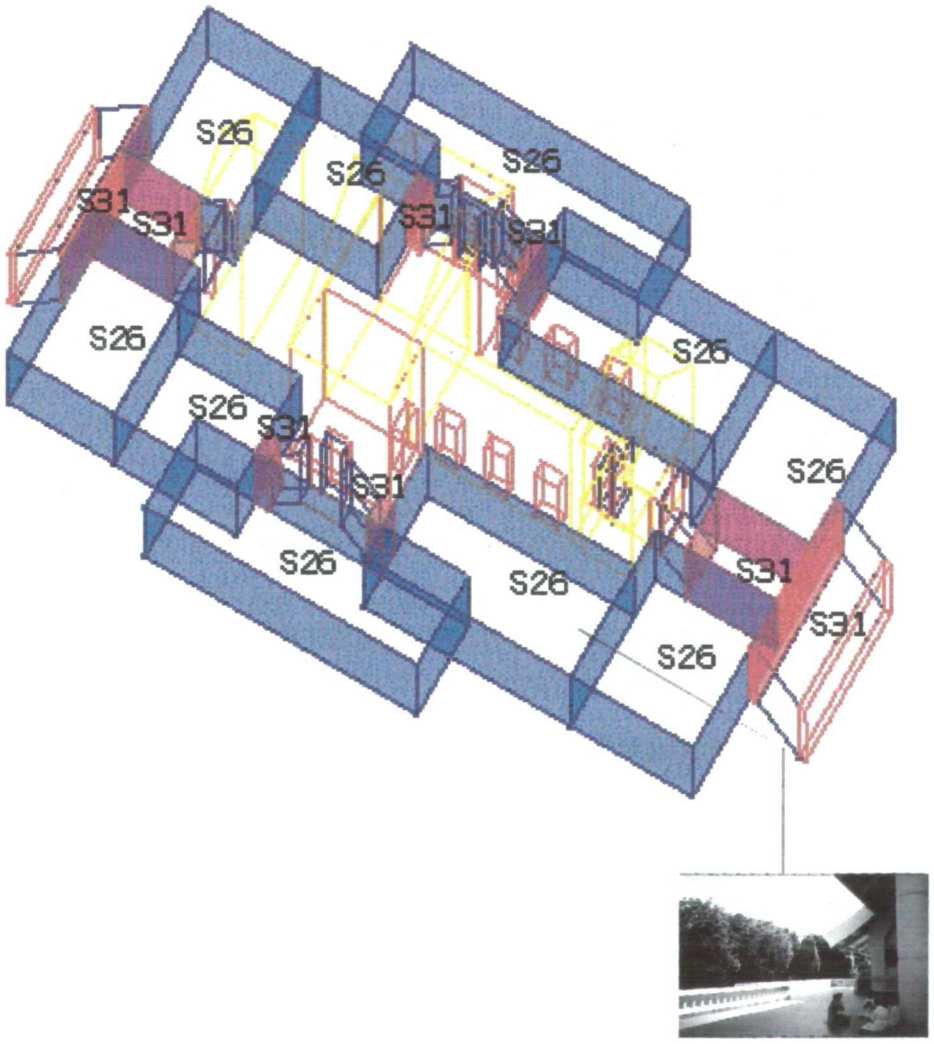
Syntax 26 is most realised as d-passage-circulation-terrace relation (140 spaces). The role of this syntax is very expansive in a Thai temple because it is in spaces where many important religious ceremonies and everyday activities happen most frequently. The

syntax also connects every part of a temple together. As a result, the spaces of terrace-based syntax 26 occupy the largest area in a temple providing the largest connections to the public. In the symmetrical design temples, syntax 26 is often equipped with distinct features of syntax 17 (c-junction-entrance-gateway) influenced by the Hindu concept of temple as the centre of the universe. Most conventional temples adopt this concept and support syntax 26 and 17 with syntax 16, c-junction-circulation-cloister (Figure 7.28)

The terrace space is usually divided into many areas especially in conventional temples 1 and 2. The closer to the *ubosot* the higher the level of these terrace spaces. As a result, the closer the centre of the temple the further it seems in one's experience moving toward the *ubosot*, as is said to be the case when trying to reach nirvana. Syntax 31 (d-junction-circulation-terrace) is closely related to syntax 26 (d-passage-circulation-terrace) in creating this labyrinthine effect in space. However, in contemporary Thai temples the main emphasis is put on passage-based relations which create the open and straightforward character of the design influenced by new concepts in Buddhism. With the absence of syntax 16 (c-junction-circulation-cloister), syntax 26 and 31 become the only transitions between the religious and public areas. Therefore, the temple boundary is very flexible and allows the overlap between non-religious and religious activities on its terrace. Terrace becomes a multi-functional area as at the Buddhapadipa temple (chapter 3) or at temple 6 where syntax 26 and 31 are in a very few spaces (Figure 7.29).

Part-whole strategies:

In the selected Thai temples, syntax 26 (d-passage-circulation-terrace) has the highest mean integration value of all the syntaxes (0.773) and often involves in the most complex part of the structure. In temples 1 and 2, syntax 26 is very powerful and plays the 'integrator' role that controls movement that are collected and delivered from all directions. Syntax 26 and 31 link exterior to the deep levels of the structure, as shown in the justified graphs of the selected temples (Figure 7.33). A temple configuration does not need as many spaces of syntax 31 (d-junction-circulation-terrace) as of syntax 26 (d-passage-circulation-terrace), especially in contemporary Thai temples where syntax 26 is often dominant and very controlling since no cloister-based syntax exists to define the temple boundary. Only few spaces of syntax 31are needed because they are designed to connect as many parts of the structure as possible.



Passage Junction Place

Figure 7.29 Syntax 26 and 31 of temple 6

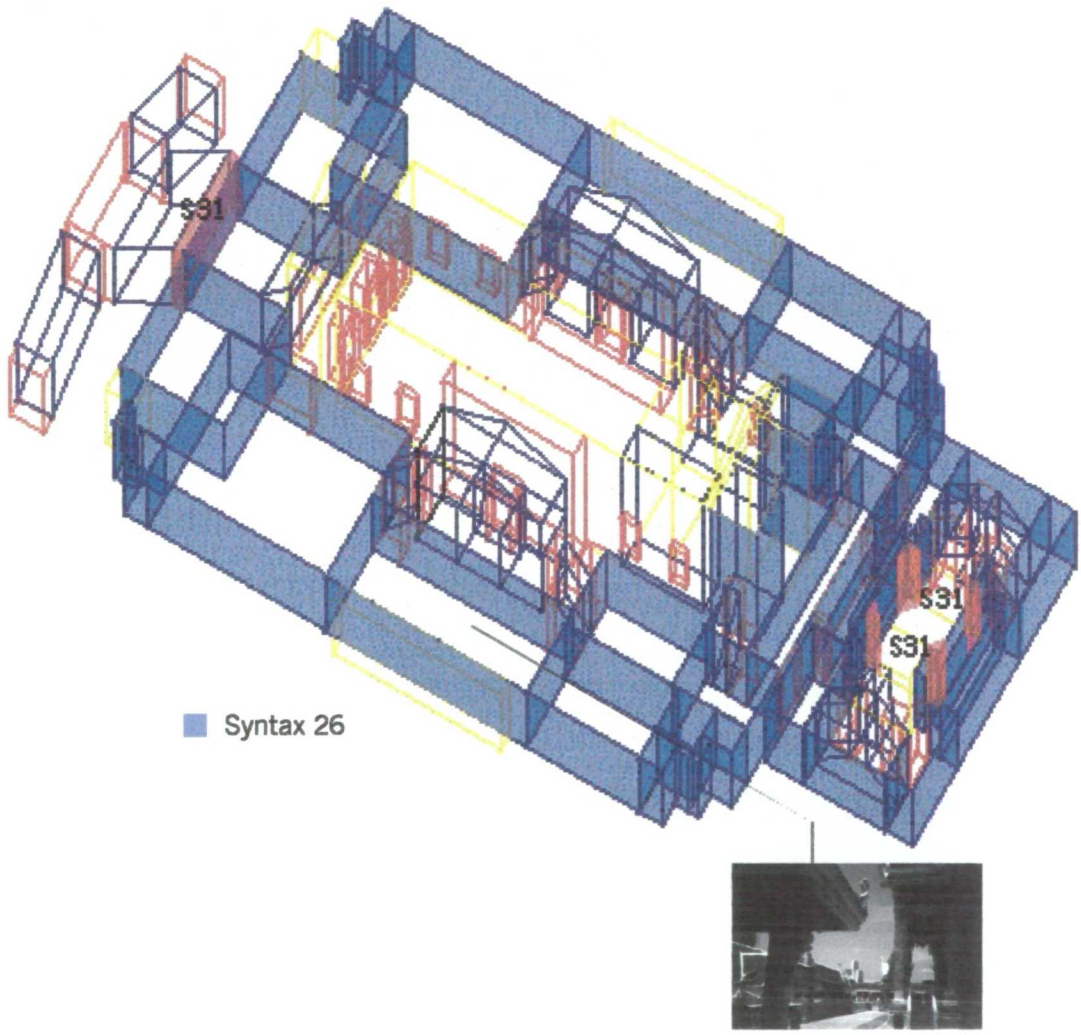
Figure 7.30 Terrace of temple 2

Figure 7.32 Ubosot of temple 3

Indoor/ outdoor strategies:

Syntax 26 and 31 are clearly the ways that Thai designers deal with religious buildings that involve a lot of outdoor activities since Thai temples have always been at the centre of communities and attract all kinds of activities. These terrace-based syntax design strategies used to define exterior space without losing the outdoor characteristics. In conventional Thai temples, syntax 26 and 31 are often regarded as spaces inside the temples since they are enclosed within the clear boundary of syntax 16 (c-junction-circulation-cloister). As a result, the terrace spaces of these temples are treated as rooms that are only different from space in the *ubosot* because their functional dimension is less religious and open to all. The configuration of syntax 26 and 31 becomes more complex when located closer to the *ubosot*; the terrace spaces can be very elaborate and sometimes parts of the terraces are turned into worship space such as syntax 36 (d-place-prayer space-terrace). These spaces have the characteristics of being a 'room' but with the 'partition-less' concept. However, in conventional Thai temples the configuration of syntax 26 and 31 on the terraces is usually simple and clear. (Figure 7.30).

The way syntax 26 and 31 are used in contemporary Thai temples is quite different from the conventional concept because the terraces of these temples are experienced entirely as outdoor space. Consequently, the configurations of d-passage-circulation-terrace and d-junction-circulation-terrace are necessarily more fragmented and directional in order to create a stronger 'partition-less' effect and to gain the impression of the terrace as a part inside the temple. (Figure 7.31). The transition from terrace-based syntax to the indoor spaces of these temples is weak and abrupt which often causes the detachment of indoor and outdoor. The conventional gateway-based syntax is no longer helpful in defining the religious zone on terraces and are pushed back from the periphery to the location next to the indoor space. In contemporary Thai temples, the focus is very much on indoor space leaving the outdoor-based syntax dependent on conventional socio-cultural values of architectural-element dimension and the concept of terraces as part of a temple.



Passage Junction Place

Figure 7.31 Syntax 26 and 31 of temple 5

Syntax 35: d-place-prayer hall-?

Temple 1					
d	**→place**	**→prayer hall**	**→room**	**= 8**	**0.750**
			→hall	**= 1**	**0.489**
Temple 2					
d	**→place**	**→prayer hall**	**→room**	**= 20**	**0.536**
			→hall	**= 1**	**0.410**
Temple 3					
d	**→place**	**→prayer hall**	**→hall**	**= 2**	**0.579**
			→cloister	**= 1**	**0.903**
Temple 4					
d	**→place**	**→prayer hall**	**→hall**	**= 1**	**0.642**
Temple 5					
d	**→place**	**→prayer hall**	**→hall**	**= 1**	**0.584**
Temple 6					
d	**→place**	**→prayer hall**	**→hall**	**= 1**	**0.762**

Table 7.4.3 Relational syntax 35 of temples 1-6

Socio-cultural strategies:

d-place-prayer hall-hall is the reference for all the syntax in a Thai temple. The main design strategy for syntax 35 is generally based on its location in the *ubosot* which is the only space that monks perform religious activities. The syntax is always realised as a big hall inside the *ubosot* or the *wihan* with the requirement that it has to be large enough to accommodate all the monks in the monastery. Therefore, the size of this space reflects the size of the temple which in turn represents the number of worshippers that regularly visit the temple. Syntax 35 is no doubt the most important place in the temple however sometimes it is almost hidden away such as the prayer hall in temple 3 where there is no window space in the *ubosot* (Figure 7.32).

The syntax is always located at the centre of a temple making it equally accessible from all directions. However, the entrances to the *ubosot* are only on the east-west axis in conventional temples. Temples 5 and 6 introduce side entrances to the space of syntax 35 which seems to be successful in allowing the faster flow of people moving in and out of the space but it is not necessarily designed for pure religious purposes. In this way, people can circulate more freely in the new designs and, as spectators not worshippers, participate in religious ceremonies. In conventional Thai temples, syntax 35 is usually in a space that has no through movement past the altar space worshippers have to return to the front of the prayer hall. This syntax creates sacred and exclusive effects in conventional temples but accessible and open in contemporary designs. d-place-prayer hall-hall syntax is conceived and used quite differently because its effect relies on the changing view of functional dimension and socio-cultural values of different times.

Part-whole strategies:

Syntax 35 appears in all selected temples and has a distinctive characteristic because it is created very exclusively in only one space, or 2 spaces in temple 3. The mean integration values of these spaces are always very low since they are usually located at the deeper parts of the structures (Figure 7.33). However, the integrated effect of prayer hall tends to increase in the contemporary temples with the highest value in temple 6 (0.762) suggesting the large impact of this most symbolic space on the whole structure of temples. But at the same time it could also suggest the lower symbolic value because of the high accessibility of the space. d-place-prayer hall-hall usually indicates the end of the journey in the temple structure, as seen in route analysis, determining how the whole will be structured both in architectural design and movement.

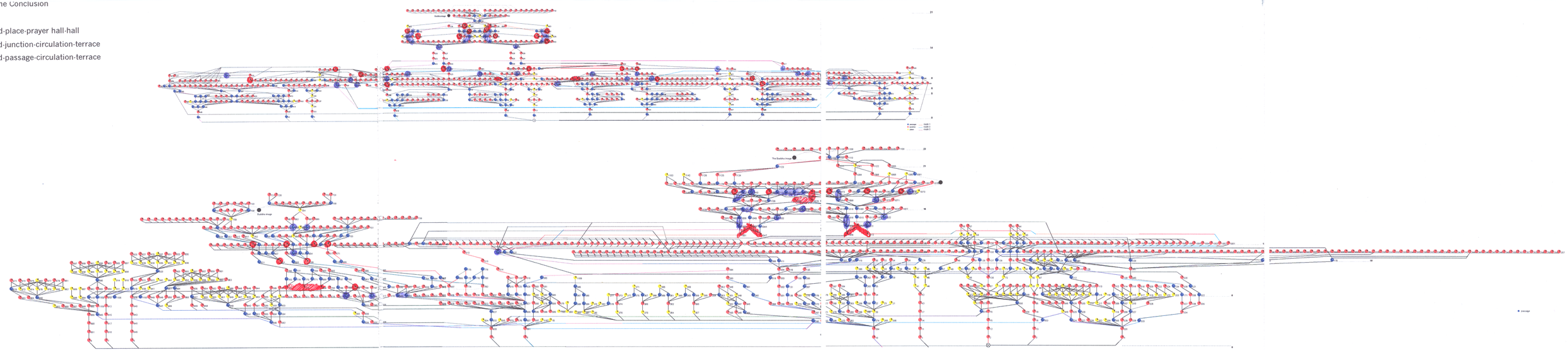
Indoor/ outdoor strategies:

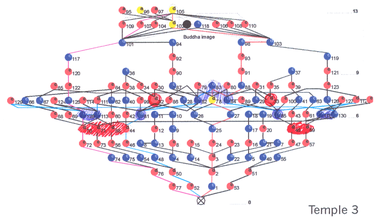
d-place-prayer hall-hall defines the *ubosot* space which can be very complex in conventional temples such as temples 1 and 2. It is usually surrounded by many small spaces with junction-based relation such as c-junction-circulation-hallway in syntax 16. In a conventional Thai temple, this syntax is very isolated from outdoor space; the only way to reach the space is through syntax 15 (c-passage-circulation-stairs) which is realised in only 4 spaces at the most in the selected temples. Therefore, the design strategies that link syntax 35 with the outdoor space tend to be through virtual rather than actual permeability such as the deep window spaces which are the reference points for the people outside the prayer hall. Syntax 3 (a-junction-orientation-window) is highly symbolic and decorated as orientation elements for people on both sides of the *ubosot* walls. The effect of window spaces is weaker in contemporary Thai temples because the indoor spaces and the prayer hall are very accessible.

In conclusion, the selected Thai temples contain all 12 structure-experience relations (section 5.3). There are fewer syntaxes that appear in only one temple than in houses, 20 in comparison to 27 suggesting that temple architecture is designed with tighter rules and requirements than houses. In other words, the design strategies in Thai temples seem to be more universal than those used in houses. However, the new temple designs become more and more individualistic as in new houses. Temple and house architecture represents the most mature and conscious design strategies we have ever known or

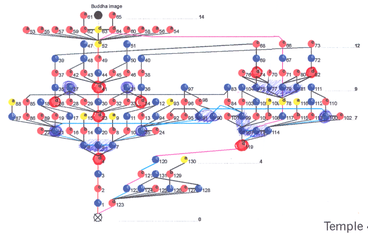
employed to make sense of the built environment. The syntaxes discussed above are the major design strategies used in these fundamental types of built environment. These design strategies are put together by both design and social activities in such ways that each syntax is part of the whole string of relations in total architectural space. The final conclusion will summarise this process in order to evaluate the concept for further use in design activities.

Syntax 35: d-place-prayer hall-hall
Syntax 31: d-junction-circulation-terrace
Syntax 26: d-passage-circulation-terrace

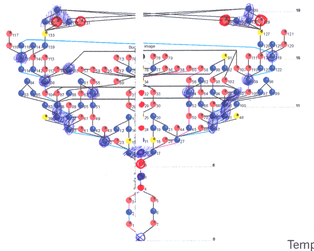




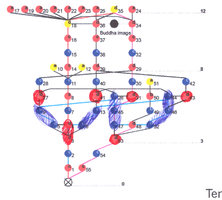
Temple 3



Temple 4



Temple 5



Temple 6

Passage Junction Place
Route 1 Route 2 Route 3

Figure 7.33 Relational syntax in temples 1-6

7.3 Relational syntax

Most relational syntaxes are created by both possibilities in social activities and conscious design intentions. The concept of relational syntax is the realisation of abstraction in pure space from the structural dimension to the experience of pure movement, which is given specific functions by social needs. Finally all considerations are given sizes and architectural meanings that communicate the building's purposes and designs. Is the relational syntax an abstract system? It is partly abstract because it firstly attempts to explain different qualities that exist in different dimensions of architectural space in relation to one another. It is also reality because secondly the real configurations are applied to the information in each dimension so that a syntax is an adaptable and workable instrument with full awareness of all dimensions. It is proposed that a space, like a design, is often influenced by the designers decision emphasising some elements in certain dimensions more than others in order to achieve specific 'effects' in the design.

These effects usually cause different architectural spaces known as houses or temples etc. Particular style or traditional architecture is the balanced intersection of socio-cultural aspects and design strategies of the design culture indicating a specific social significance in people's mind. How does the culture affect and manifest itself in the object and how does it help finalise design strategies used in the design process? The designs and social requirements co-exist as the cause and effect of each other; without one the reality fails. The information from all selected examples is seen together as different 'effects' that are in used and realised in real buildings. There are many differences between Thai traditional houses and temples and some qualities are more crucial than others.

This is because there are different targets in designing a building. One aim is to understand the socio-cultural aspects in activities while another aims to understand architecture as an object in a social context. The questions would then be, e.g. 'which spaces contribute to the most engaging experience throughout the building?' or 'which functions attract movement the most?', etc. The research has looked into such questions at a conceptual level through actual participation in the selected examples. Consequently, the on-site observations are done with the focus on properties in dimensions that make up relational syntax not on the impression in design. Architecture, when built, becomes an object open to limitless subjectivity concerning perception. The true essence of being in and understanding buildings is not in perception but it passes through our eyes as

instruments and is formed into conceptions making each piece of architecture intelligible for social activities.

Traditional house and temple designs in Thailand

As in any culture, the basic factors of Thai architectural spaces are in spaces to move and spaces to use. For the selected Thai houses, the relational syntaxes are socially configured to achieve the effect of 'privacy' which is expressed in the forms of the relational syntaxes that are the most common in all selected houses such as those of a- -bathroom-room, a- -bedroom-room, c-**passage**-circulation-stairs, c-**junction**-entrance-stairs and d-**passage**-circulation-terrace relations. These relational syntaxes are dominant among many more relations that either fail to be realised into architectural reality or are not as consistent in the selected spaces as the above-mentioned syntaxes. As a whole, it seems that the 'privacy' effect in Thai houses is structured by the design strategies that relate to these five relational syntaxes. Numerically, these syntaxes contribute only about 5-7% in numbers of spaces with integrated effects of 1.007-0.699 (Tables 7.3.1-7.3.3).

The selected Thai temples are commonly structured by design strategies to achieve the general effect of 'sacredness'. Five relational syntaxes appear in all six temples: c-**passage**-circulation-stairs, c-**junction**-circulation-terrace, d-**passage**-circulation-terrace, d-**junction**-circulation-terrace and d- -prayer hall-hall relations. These syntaxes have about 7 to less than 1% shares in the whole space of the selected temples and have integration values that range from 0.773-0.578 (Tables 7.4.1-7.4.3). From the syntactic information and real experience, the relational syntaxes of the selected Thai houses comparatively seem to be more 'obvious' effects than those in temples which tend to be subtly configured. These facts correlate to the uncompromising idea of 'privacy' and the seductive 'sacredness' in house and temple architecture in general and those of Thailand in particular. In this way, space seems to turn into an instrument that can create certain effects by its configurations.

Intuitively, some common relational syntaxes extracted from the selected Thai houses and temples are not very surprising. However, the main point is in the fact that the process and effects that these syntaxes create in architectural reality are very useful in dealing with design activities, especially when one is actually creating the design. The way

that these syntaxes relate to one another seems to naturally depend on their socio-cultural aspects and the activities that influence where parts fit into the whole. This step in the design process, especially in traditional Thai design, seems to be a bi-directional process in which designers simultaneously design indoor ←→outdoor space in relation to each other. Therefore, if we put these relational syntaxes in relation to one another as they are dealt with in the design process of Thai houses, from outside to inside and vice versa, they could be located like this:

c-**junction**-entrance-stairs←→c-**passage**-circulation-stairs←→d-**passage**-circulation-terrace←→a- -bedroom-room←→a- -bathroom-room

or in that of Thai temples:

d-**junction**-circulation-terrace←→d-**passage**-circulation-terrace←→c-**junction**-circulation-terrace←→c-**passage**-circulation-stairs←→d- -prayer hall-hall.

These sequences of the structure in houses and temples are not to be mistaken as the design or building itself but essential sequences in experience. Practically, these syntaxes are complemented by other syntaxes in order to complete the discourse on being a piece of architecture. It is not the objective of the research to establish a rule or a sentence for these syntaxes since designs for social activities are never read only using one dimension. The value of these syntaxes is the simultaneity of effects they communicate to us, the user and designer, in the form of genotype or discourse. However, in reality architecture is never reduced to any of those qualities since there is always tension between the intrinsic and extrinsic qualities of architectural space caused by the activities of using and designing architecture. Therefore, the concept of relational syntax is based on its ability to choreograph elements that make up a syntax in such a way that the designs can be cross checked and related with other properties that make such spaces.

'In language we use both particular and universal terms. A particular term is 'bird', as in 'that bird flies'. We may point to the bird and indicate it as we say its name. A universal term is 'birds' as in 'all birds fly', 'Birds', in this case, cannot be indicated, since what is referred to is the class of all birds, whose locations are for the most part unknown to us. 'Birds' is therefore an abstract concept. One would suspect it of being a pure mental construct, were it not for the fact that it seems to depend on some abstract notion of a bird, which somehow sums up 'birdness', yet it is present in all real birds, regardless of their individual variation. 'Birds' seems to imply some kind of 'bird genotype'.' (Hillier, 1984b:70).

We often know 'C-A-T' (various architectonic readings) from its hostility to 'birdness' (abstraction in architectural space). The co-existence of 'birdness' and C-A-T (as in Eisenman, 1987) is in the idea of a self-referential object. Genotypes found in objects determine the overall character of that object and thus configurations that say C-A-T or A-C-T etc. It is self-referential since the understanding of the object is based on the reality of elements that create it (e.g. architectural elements create the reality of 'building') which are the set of variations that signify that particular object only. The configuration of the elements, C-A-T, is therefore limited to the fact that it only refers to the idea of 'birdness' or 'building' as they are commonly understood. In this way, the configuration retains its semantic rigour through *particular* configurations, e.g. C-A-T and A-C-T, that convey some meanings to our senses. Relational syntax portrays the extrinsic together with the intrinsic properties of an architectural space. Consequently, for example, the structural aspects are as visible as the semantics in an object and therefore, understood independently from within their paradigms.

A building is seen having layers of structural, experiential, functional and architectural-element configurations that are totally independent as well as relative. Approaching architecture and its design in this way, the dynamic quality of architectural space can be more consciously appreciated and perhaps even achieved. As is the case for Thai houses, the analysis showed that the designs are strongly dynamic in all of spatial dimensions. As a whole, Thai houses can be very open or very closed from exterior space. Internally, a house is not designed as a goal-oriented architecture. A house is the end of the journey itself or as a 'place' as a whole or as the union of many places in the case of Thai houses. It tends to have many functions in every part of its spatial organisation. In this respect, it could be said that houses, with space types as varied as temples, generate the whole experience using a series of 'function-setting' spaces. On the other hand, temple spaces have less functional meaning but are stronger in architectonic value that is, 'goal-oriented' passage type or 'decision-making' junction type. The inner spaces of houses are, needless to say, less accessible than the so-called sacred spaces of temples. Socio-cultural factors create these different characteristics of space in houses and temples.

A temple is not as 'functional' compared to house architecture. The total concept of the design is emphasised on the sacred buildings being 'hard to reach' and are thus associated with the idea of 'passage and junction' in movement. Thai temples do not actually have

the idea of seclusion of sacred space but the idea of sequential seduction of space beckoning people to always move toward its inner core. The designs are not used to stop the movement but dynamically promote it in a subtle way. In this way, Thai temples do not employ the idea of 'house of god' but the idea of 'meeting house' while Thai houses employ very strongly the idea of total seclusion of the inner core. Even in such small spatial configurations, compared to those of temples, one can use and walk in the architecture all day without the need to get into an inner core which is kept intact as if it were some kind of sacred place. Here supreme beings reside in the owner. In this way, the real 'centre of the universe' is not temples but houses.

'...sacred cord unrolled is bound thrice in a counterclockwise direction usually to the pedestal with the Buddha image,...One end goes out through a window of an opening and encircles the perimeter of the house and then returns to the pedestal of the Buddha image.' (Rajadhon, 1968:262). This ceremony shows the similarity in the concept behind houses and temples. While temples have altars and Buddha images as the centre of attention, houses also have Buddha images as the centre of its existence in the spirit room next to the owner's living unit. A Thai house, the building and site, is purified by the same beliefs as that of a temple. There must be the ceremony that signifies the whole area where functions are to be placed and used. The relationship of functions and architectural element is 'confirmed' in this way by such a ceremony or a strategy. In this way, an architectural element is made 'suitable' and is now qualified for its function.

The example strategy is also used as the way to quantify the area and space for the good 'function', means 'living' for houses and 'worshipping' for temples, to take place. A type of function is once more defined as 'proper' by the acknowledgement of the design in such an architectural element. Here architectural design and socio-cultural 'design' are superimposed. Once these two are drawn on top of each other and are declared as a 'fit pair', the beginning of dwelling and worshipping places emerges. The integration of these two things is flexible if one observes the appropriate steps whenever one wants to add or adapt parts of houses or temples. Similar ceremonies have to take place again after changes for the same purpose of making (and inspecting in a way) the two dimensions or the two strategies work well together and are accepted by people in society as such. In this way, the ceremonies employed are used as devices that relate many social requirements back to the way people live.

Relational syntax relates many aspects of architectural space back to the basics of use and design firstly in order to become aware of these aspects, understand them and finally give them the appropriate treatment when using or designing such space. Architectural elements when read together usually create meanings other than themselves. For example, elements such as columns and walls can be read together as room or passage or altar or a composition meaning that they can be read as a functional object, experience, configuration of belief or an art object. In most situations, users do not need to be conscious of the building as the work of multi-dimensions in architectural space. They read those elements together as the representation of an architectural object which means they *acknowledge* those elements as signs of construction (Eiseman, 1999) or just as something pleasant. *'There is a certain efficiency if one erects a building that has a special aura, a life and people feel comfortable in it. That is an efficiency which is not quantifiable, except after a time. All this talk about the social responsibility and meaning of architecture...in the end it is quite simple. If it is a pleasant location, people will use it.'* (Gehry, 1996:16). This is certainly not the case when approaching from the designer's end of the relational syntax where something like 'pleasant' does not lead anywhere in design.

In this way, it seems that these realisations and procedural ideas about the design process do not automatically suggest a piece of ready-made good architecture because a building is not merely a well-thought out functional object or a system of connections. The design of a corridor may, in theory, be that it should be as efficient as possible but in practice experiential value plays a major role so that a corridor might become zigzag or dissolve into some parts of building to emerge again, etc. In short, activities in buildings are a very diversified and not formula-based process. This process is possible after an architect has contemplated the problem of the given question or 'brief' and then decides which techniques are most suitable. After the analytical phase when most components of the building have been functionally assigned, intuition comes into play. The process starts from intuition to analysis and back to intuition again. The final refinement of a design employs both analytical and intuitive means. Relational syntax portrays such a process and shows that some 'discourses' are realised most of the time or some are just often and some fail to become architectural reality in relation to intuition in design and use.

It is intuition that resides in body and bodily movement that forms this conceptual side of architectural space which seems to remain inside our memory and become the basis for the mechanism of people's movement in most pieces of architecture that they will come to be in contact with. In this way, the conceptual experience exceeds three-dimensional consideration because it incorporates both real movement and time that happens inside architectural space. The elements in a string of relational syntax make the concept of each space more manageable and accessible in relation to body movement. This is because movement of the body in each dimension influences the existence of one another. For example, a-type space has the concept of ending experience of movement therefore it tends to associate bodily movement with place-type space. While in the functional dimension, the movement experience tends to create more static activities such as bedroom which in turn suggests the architectural reality of being a room.

Within this room, the concept of relational syntax can also be useful in designing detailed treatments of room space. The conclusion from an attempt to reach a deeper understanding of architectural space thus seems to suggest yet a deeper one. The movement and activities inside a space can be further analysed in the same way as the relational syntax of a whole building. Take an actual building, many unconfined activities take place inside in specific ways which gives the architecture its unique quality and allow it to become that piece of architecture. The same is proposed to be the case at the scale of every single space as well. The micro scale of movement reveals yet another possibility of developing design strategies that are more precise and effective for bodily movement of social activities in architectural space.

A lesson can be taken by looking at an example of Thai design. *Mai Thoranee* or 'Ground wood' is a part of every doorway in traditional Thai houses and temples (Figure 7.34). The Thai believe that this part of a doorway should not be stepped on. In houses, this piece is about two to three inches wide while in temples it can be up to 50-70 cm which is the size of the pocket space at the doorway. In the case of temples, another piece of wood is put on top of this piece so that it cannot be stepped on directly. As a result, doorway spaces strongly differentiate indoor from outdoor spaces and have their own identity as junction spaces especially in temples.

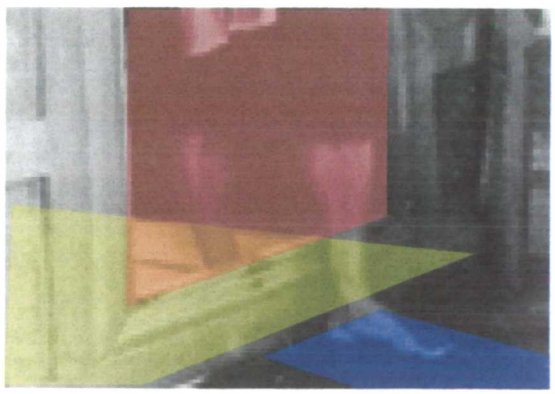


Figure 7.34 Mai Thoranee

The delicate attention paid to architectural elements and space is common in Thai architecture. It is the design strategy that gives as much importance to people's movement as the functional notion of that architectural element. In this way, architectural space is strongly experienced because one has to pay more attention to the way one moves in such a space in order that the functional dimension is carried on. The invisible experiential function is made to be felt as much as the functional one. This fact also suggests that spaces have an independent quality apart from other typical qualities such as functional quality. Deeper socio-cultural realisations may also be deduced from the above example; that is, the pocket space together with the 'ground wood' at doorways of traditional Thai architecture is a reminder of oneself. When one finds it difficult to step over this element, one should realise that one has become old and should make all the more effort to live well and strive for even more merit.

The research has shown that many properties in the multi-dimensional architectural space are highly relative. The dead-end space a-type is closely related to place-type experience in houses but with junction-type in temples. This place-type has been assigned typical functions like bedroom, bathroom or others in houses while the junction-type is typically associated with the concept of circulation and entrance in both Thai houses and temples. The same applies to other syntaxes. The circular connections, c- and d-type spaces, are more related to the experience of junction and passage, respectively. c-junction spaces are often realised as the outdoor space on the terrace or in the gateways of Thai houses and temples while d-passage-circulation-terrace is the most common in the design of both houses and temples. d-place is used as living space in Thai house terraces but as worshipping space in Thai temples. This is important information about architectural space that could be used as a rough guide but the design itself does not end here as it lives on in the larger notion of concept such as 'privacy' or 'sacredness' in the architecture of houses or temples.

Further research focusing on the biomechanics and aesthetics of movement in relation to architectural space seems to be the next question for one interested in designing and thinking about architecture in this way. There are many cautions in dealing with images that are expected to be very rich in such a level. Images generated from computers, which often use the proximic concept to merge many 'shapes' together, are not 'form' that are being created. The deep structure is not really affected in this way compared to

what has been achieved in new sciences such as genetic-engineering. The same in architecture, techniques based on shapes such as montage or morphing can only provide an 'impression' but not the properties in deep structure of space that causes such a form. In this way, it seems that many 'new and non-existence forms' that are claimed to be created in this way remain only impressions. The efforts should be emphasised on the way to put each molecule of architectural space to work and looking at the relative values of space not the isolated impression of form.

Appendices

Calculation formula and explanations of syntactic values

• Integration value = 2(d-1) / k-2

d – mean depth of spaces from the space

k – the total number of spaces in the graph (Hillier, Hanson and Graham, 1987:364)

The RA value derived from the above formula needs to be converted into RRA value in order to compare spaces with different numbers in graphs.

RRA = RA/Dk

Dk – see Hillier and Hanson, 1984:112

In this study, the integration value was calculated by computer which gives the reciprocal value of RRA to each space i.e. the high value means the high integration and the less value means less integration.

• Space-link ratio = number of links + 1 / the number of spaces (Hillier, Hanson and Graham, 1987:373)

The value of 1 → a tree-like complex

More than 1 → increasing degree of ringiness

• Base difference factor (H*)

H* = H-ln2/ln3-ln2

H = - sum of [a/t.ln(a/t)] + [b/t.ln(b/t)] + [c/t.ln(c/t)]

a, b and c are the minimum, mean and maximum integration values of the spaces

t = a+b+c

'...the closer to 0 the difference factor, the more differentiated and structured the spaces or labels; the closer to 1, the more homogenised the spaces or labels, to a point where all have equal integration values and hence no configuration difference exist between them.' (Hanson, 1999).

Glossary of terms

Ayuthaya: The second capitol of Thailand (1357-1757). Its style is the most influential in the design of the traditional Thai architecture and defines what is known as central Thai style. Many works created in this period are considered as the masterpieces of both traditional Thai houses and temples. It is located at about 300 kilometres to the north of Bangkok.

Baan: House or the area of the house or the village.

Bodhisattava: The Buddha-to-be figures. Buddha himself is said to have been born many times as *Bodhisattavas* in order to gain wisdom and good deed and become mature as the Buddha. In Thailand, revered monks are seen as similar figures to *Bodhisattava*.

Brahmanism: The ancient religion in India which subscribes to the idea of different gods who create, preserve and destroy universe and earth. Originated at around the second millennium BC, it is the pre-Hindu religion in India and is the doctrine that influenced Buddha to search for nirvana.

Buddhawas: The area which is purified by religious ceremonies for the exclusive uses of religious ceremonies. It is the most important area of a monastery where the temple is located. The area is designated by *sema* leaves. The word means the area of Buddha and his philosophy.

Chedi: Originally, the monument built to commemorate the important locations in Buddha life. Later, it is built to accommodate the bone of Buddha, his philosophy and his belongings. Nowadays, most *chedis* are built as the reminder of Buddha and his philosophy and normally accommodate revered Buddha images or ashes of important people.

Hinayan: It is also known by the name *Theravas*. It is the dominant doctrine of Buddhism practised in Thailand and Sri Lanka. It has a meaning, the lesser way, put by the *Mahayan* Buddhists in contrast to the meaning of *Mahayan*, the great way.

Hinduism: The descendent of *Brahmanism* originated in India. It is the pre-Buddhism religion in India.

Mahayan: The dominant doctrine of Buddhism practised in India, Nepal, Tibet, China and Japan. The doctrine is practised in Thailand in a lesser degree than *Hinayan*.

Mandala: The Indo-Tibatan concept of universe. It has a powerful centre surrounded with small districts and verandas as junctions between them.

Meru: It is known as *Phra Sumen* mountain in Thai. According to Hinduism, it is the centre and the axis of the world and universe where gods reside. Its configuration influences the

design of *chedis* and other details in Thai architectural elements. The king's palace is usually associated with the concept of this mountain.

Mon: The ethnic group in Thailand who has a lot of influence on Thai socio-cultural, especially in decorative art. It is believed that they have been in the area of the present Thailand between the seventh and eleventh century AD.

Naga: It is *Naak* in Thai. The king of serpents who lives in the underworld, it is the symbol of water, *nam*. In temples, *naga* symbol is used in various places as it is recognised as the guardian and the loyal supporter of Buddha.

Nirvana: The state of nothingness, void of sorrow and happiness. It is achieved by Buddha through the enlightenment. One who achieves nirvana shall surpass the cycles of deaths and rebirths and thus be totally free.

Rama: The human reincarnation of god *Vishnu* the preserver. Thai kings are always associated with this figure for their power, care and protection are their central images.

Rattanakosin: The capitol of Thailand from 1757 to present. As a city, it is also known by the name Bangkok. The name is also used to indicate the traditional Thai style that was mainly originated during the reign of Rama I to Rama III (1757-1851). The style is basically the revival of the classical Ayuthaya style together with some Chinese and Western influences that came in during the reign of Rama III.

Ruen: The compound of living units. Its meaning is different from *baan* in the sense that it exclusively refers to the upper floor of the Thai house. It is usually used with the verb 'going up' while *baan* refers to the whole architecture or the area.

Sala: The open pavilion usually for public use, found in *wat* or along the streets.

Sangkawas: The area of a monastery which is outside the *Buddhawas* area. Monk houses and other facilities such as school, pavilions, *salas* etc. are located in this area. The word means the area of monks.

Sema: The demarcation stone used to signify the sacred area of the *ubosot*. It marks the end of profane world. Monks will conduct religious ceremonies such as ordination within the area defined by these stones.

Sukhothai: The first capitol of Thailand (1257-1357) where the original concept of the traditional Thai architecture was first developed. Its style is considered as classical that influences all the works produced by the Thai artisans especially Buddha image designs.

However, houses and temples from its time are all in ruin or totally disappear. It is located about 700 km north of Bangkok.

Thamakaya: A relatively new interpretation in Buddhism originated by a highly respected monk. It is very popular as well as controversial. In 1998, there has been a major investigation into its philosophy when the abbot of Wat Phra Thamakaya declares that nirvana is self not nothingness. The doctrine bases its practice on meditation which is said to bring one closer and faster to what they call nirvana. The doctrine is very well known around the world.

Triphumpraruang: Also known as *Triphumikatha* which means Three-World cosmography which has its centre at the *Meru* mountain. It was translated and written for the public by King Maha Thammaracha I, the fifth king of Sukhothai, in 1340. It describes the Buddhist concept of heaven, earth and hell. The concept was employed in designing houses and temples, from its planning down to architectural details.

Ubosot: The ordination hall. This building has to be at least big enough for the assembly of all the monks who reside in the monastery. The principal Buddha image will normally be placed inside this building and facing the east which is the main entrance of the building. Its plan is normally conceived in a rectangular shape.

Vishnu: One of the three major gods in Hinduism. It is also known by the name *Phra Narai* in Thai. This god is believed to incarnate into different figures to fight with devils on earth and give protection to human.

Wat: Temple or the whole area of a monastery which include monk houses, school, yard, meditation area, etc.

Wihan: The preaching hall where monks give summons to the worshippers. It is also used to keep some revered Buddha images. Its size is not limited by the requirement that it has to accommodate all the monks in the monastery. Therefore, there are variations of *wihan* that could range from very small to very big. Normally, it is conceived in the same rectangular shape as the *ubosot*

Relational syntax of houses 1-6

Structure	Experience	Function	Arch. element	No. of space	Integration value
Syntax 1: a-passage					
House 1-6					
a	→passage	→0			
Syntax 2: a-junction					
House 1-6					
a	→junction	→0			
Syntax 3: a-place-living area-?					
House 1					
a	→place	→living area	→hall	= 2	0.647
House 2					
a	→place	→living area	→pavilion	= 2	0.674
			→hall	= 1	0.834
			→terrace	= 1	0.834
House 3, 6					
a	→place	→living area	→0		
House 4					
a	→place	→living area	→terrace	= 1	0.829
			→hallway	= 1	0.591
House 5					
a	→place	→living area	→courtyard	= 1	0.859
			→pavilion	= 1	0.542
Syntax 4: a-place-bathroom-?					
House 1					
a	→place	→bathroom	→room	= 2	0.635
House 2					
a	→place	→bathroom	→room	= 1	0.640
House 3					
a	→place	→bathroom	→room	= 1	0.950
House 4					
a	→place	→bathroom	→room	= 4	0.532
House 5					
a	→place	→bathroom	→room	= 6	0.747
House 6					
a	→place	→bathroom	→room	= 8	0.739
Syntax 5: a-place-bedroom-?					
House 1					
a	→place	→bedroom	→room	= 1	0.682
House 2					
a	→place	→bedroom	→room	= 1	0.612
House 3					
a	→place	→bedroom	→room	= 10	0.872
House 4					
a	→place	→bedroom	→room	= 2	0.834

House 5

a	→place	→bedroom	→room	= 3	0.697

House 6

a	→place	→bedroom	→room	= 7	0.506

Syntax 6: a-place-kitchen-?

House 1, 3, *4, 5, 6*

a	→place	→kitchen	→0		

House 2

a	→place	→kitchen	→room	= 1	0.663

Syntax 7: a-place-dressing room-?

House 1, 3, 6

a	→place	→dressing room	→0		

House 2

a	→place	→dressing room	→room	= 2	0.553

House 4

a	→place	→dressing room	→room	= 2	0.494

House 5

a	→place	→dressing room	→room	= 2	0.589

Syntax 8: a-place-storage-?

House 1, 2, 4, 5

a	→place	→storage	→0		

House 3

a	→place	→storage	→terrace	= 3	0.908
			→room	= 1	0.671

House 6

a	→place	→storage	→room	= 10	0.568

Syntax 9: a-place-bathing area-?

House 1, 2, *4, 5, 6*

a	→place	→bathing area	→0		

House 3

a	→place	→bathing area	→terrace	= 2	0.814

Syntax 10: a-place-prayer hall-?

House 1, 2, *4, 5, 6*

a	→place	→prayer hall	→0		

House 3

a	→place	→prayer hall	→hall	= 1	1.132

Syntax 11: a-place-pantry-?

House *1, 2, 3*, 6

a	→place	→pantry	→0		

House 4

a	→place	→pantry	→courtyard	= 1	0.609

House 5

a	→place	→pantry	→room	= 1	0.675

Syntax 12: a-place-study room-?

House *1, 2, 3*, 4, 6					
a	→place	→study room	→0		
House 5					
a	→place	→study room	→room	= 2	0.704

Syntax 13: a-place-spirit room-?

House *1, 2, 3*, 4, 6					
a	→place	→spirit room	→0		
House 5					
a	→place	→spirit room	→room	= 1	0.675

Syntax 14: a-place-dayroom-?

House *1, 2, 3*, 4, 5					
a	→place	→dayroom	→0		
House 6					
a	→place	→dayroom	→room	= 2	0.845

Syntax 15: a-place-dining room-?

House *1, 2, 3*, 4, 5					
a	→place	→dining room	→0		
House 6					
a	→place	→dining room	→room	= 1	0.589

Syntax 16: b-passage-circulation-?

House 1-2					
b	→passage	→circulation	→0		
House 3					
b	→passage	→circulation	→stairs	= 1	1.038
House 4					
b	→passage	→circulation	→stairs	= 1	0.674
House 5					
b	→passage	→circulation	→terrace	= 1	0.781
House 6					
b	→passage	→circulation	→stairs	= 3	0.735

Syntax 17: b-junction-circulation-?

House 1					
b	→junction	→circulation	→doorway	= 3	0.844
House 2					
b	→junction	→circulation	→doorway	= 5	0.827
House 3, *4, 5, 6*					
b	→junction	→circulation	→0		

Syntax 18: b-junction-living area-?

House 1, 5, 6					
b	→junction	→living area	→0		
House 2					
b	→junction	→living area	→veranda	= 3	1.098
House 3					
b	→junction	→living area	→veranda	= 1	0.872

House 4

b	→junction	→living area	→veranda	= 1	0.582

Syntax 19: b-junction-foyer-?

House *1, 2, 3*

b	→junction	→foyer	→0		

House 4

b	→junction	→foyer	→room	= 1	0.598

House 5

b	→junction	→foyer	→veranda	= 2	0.878
			→room	= 1	0.973
			→courtyard	= 1	0.781

House 6

b	→junction	→foyer	→veranda	= 7	0.597

Syntax 20: b-junction-entrance-?

House *1, 2, 3*, 4, 6

b	→junction	→entrance	→0		

House 5

b	→junction	→entrance	→terrace	= 1	0.642

Syntax 21: b-place-bedroom-?

House 1, 3, 6

b	→place	→0			

House 2

b	→place	→bedroom	→room	= 2	0.674

House 4

b	→place	→bedroom	→room	= 2	0.519

House 5

b	→place	→bedroom	→room	= 3	0.696

Syntax 22: b-place-living area-?

House 1, 3, 6

b	→place	→0			

House 2

b	→place	→living area	→0		

House 4

b	→place	→living area	→terrace	= 1	0.711

House 5

b	→place	→living area	→veranda	= 1	0.837

Syntax 23: b-place-bathroom-?

House 1, 3, 6

b	→place	→0			

House 2, 5

b	→place	→bathroom	→0		

House 4

b	→place	→bathroom	→room	= 1	0.467

Syntax 24: b-place-living room-?

House 1, 3, 6					
b	→place	→0			
House 2, 4					
b	→place	→living room	→0		
House 5					
b	→place	→living room	→room	= 1	0.820

Syntax 25: c-passage-circulation-?

House 1					
c	→passage	→circulation	→stairs	= 4	0.795
			→terrace	= 1	1.242
House 2					
c	→passage	→circulation	→stairs	= 5	0.977
			→terrace	= 1	1.145
House 3					
c	→passage	→circulation	→stairs	= 4	0.954
			→veranda	= 3	0.640
House 4					
c	→passage	→circulation	→courtyard	= 2	0.703
			→stairs	= 2	0.985
			→hallway	= 1	0.691
House 5					
c	→passage	→circulation	→stairs	= 4	1.025
			→terrace	= 2	1.016
House 6					
c	→passage	→circulation	→stairs	= 2	0.799
			→courtyard	= 2	0.778
			→terrace	= 2	0.697

Syntax 26: c-passage-living area-?

House 1, 3, *4, 5, 6*					
c	→passage	→living area	→0		
House 2					
c	→passage	→living area	→terrace	= 1	1.658

Syntax 27: c-passage-garden-?

House *1, 2, 3*, 5, 6					
c	→passage	→garden	→0		
House 4					
c	→passage	→garden	→terrace	= 1	0.499

Syntax 28: c-passage-entrance-?

House *1, 2, 3*, 4, 6					
c	→passage	→entrance	→0		
House 5					
c	→passage	→entrance	→stairs	= 1	1.084
			→courtyard	= 1	1.002

Syntax 29: c-passage-foyer-?

House *1, 2, 3*, 4, 5					
c	→passage	→foyer	→0		
House 6					
c	→passage	→foyer	→courtyard	= 2	0.888

Syntax 30: c-junction-circulation-?

House 1					
c	→junction	→circulation	→doorway	= 6	0.851
House 2					
c	→junction	→circulation	→terrace	= 2	0.863
House 3					
c	→junction	→circulation	→terrace	= 2	1.236
			→veranda	= 1	0.828
House 4					
c	→junction	→circulation	→stairs	= 1	1.040
House 5					
c	→junction	→circulation	→stairs	= 2	0.947
			→courtyard	= 1	0.855
House 6					
c	→junction	→circulation	→courtyard	= 2	0.956
			→terrace	= 1	0.714

Syntax 31: c-junction-living area-?

House 1					
c	→junction	→living area	→veranda	= 1	0.745
House 2, *4, 5, 6*					
c	→junction	→living area	→0		
House 3					
c	→junction	→living area	→veranda	= 2	1.063

Syntax 32: c-junction-entrance-?

House 1					
c	→junction	→entrance	→stairs	= 2	0.733
House 2					
c	→junction	→entrance	→stairs	= 5	0.898
House 3					
c	→junction	→entrance	→stairs	= 4	0.849
House 4					
c	→junction	→entrance	→courtyard	= 2	0.721
			→stairs	= 3	0.823
			→terrace	= 1	0.760
			→gateway	= 1	0.642
House 5					
c	→junction	→entrance	→0		
House 6					
c	→junction	→entrance	→doorway	= 2	0.936

Syntax 33: c-junction-foyer-?

House *1, 2, 3*, 6					
c	→junction	→foyer	→0		
House 4					
c	→junction	→foyer	→veranda	= 2	0.684
			→terrace	= 2	0.633
			→room	= 1	0.666
House 5					
c	→junction	→foyer	→room	= 1	0.882

Syntax 34: c-junction-pantry-?

House *1, 2, 3*, 5, 6					
c	→junction	→pantry	→0		
House 4					
c	→junction	→pantry	→room	= 1	0.611

Syntax 35: c-place-living area-?

House 1					
c	→place	→living area	→veranda	= 2	0.928
			→hall	= 1	0.931
			→terrace	= 1	0.814
			→pavilion	= 1	0.734
House 2					
c	→place	→living area	→terrace	= 1	1.077
House 3, 6					
c	→place	→0			
House 4					
c	→place	→living area	→terrace	= 1	0.498
House 5					
c	→place	→living area	→terrace	= 1	1.078
			→courtyard	= 1	0.749

Syntax 36: c-place-bedroom-?

House 1					
c	→place	→bedroom	→room	= 2	0.574
House 2					
c	→place	→bedroom	→0		
House 3, 6					
c	→place	→0			
House 4					
c	→place	→bedroom	→room	= 1	0.599
House 5					
c	→place	→bedroom	→0		

Syntax 37: c-place-bathroom-?

House 1, 2, 5			
c	→place	→bathroom	→0
House 3, 6			
c	→place	→0	

House 4

c	→place	→bathroom	→room	= 2	0.689

Syntax 38: c-place-storage-?

House 1, 2, 5

c	→place	→storage	→0		

House 3, 6

c	→place	→0			

House 4

c	→place	→bathroom	→room	= 1	0.725

Syntax 39: c-place-dressing room-?

House 1, 2, 5

c	→place	→dressing room	→0		

House 3, 6

c	→place	→0			

House 4

c	→place	→dressing room	→room	= 1	0.698

Syntax 40: c-place-pantry-?

House 1, 2, 5

c	→place	→pantry	→0		

House 3, 6

c	→place	→0			

House 4

c	→place	→pantry	→room	= 1	0.698

Syntax 41: d-passage-circulation-?

House 1

d	→passage	→circulation	→terrace	= 3	0.996

House 2

d	→passage	→circulation	→terrace	= 5	0.977

House 3

d	→passage	→circulation	→terrace	= 6	1.339

House 4

d	→passage	→circulation	→terrace	= 9	0.776
			→courtyard	= 7	0.890
			→room	= 1	0.677

House 5

d	→passage	→circulation	→courtyard	= 6	0.999
			→terrace	= 1	1.288

House 6

d	→passage	→circulation	→courtyard	= 2	1.129

Syntax 42: d-passage-garden-?

House *1, 2, 3*, 5, 6

d	→passage	→garden	→0		

House 4

d	→passage	→garden	→terrace	= 1	0.686

Syntax 43: d-passage-entrance-?

House *1, 2, 3*, 4, 6					
d	→passage	→entrance	→0		
House 5					
d	→passage	→entrance	→stairs	= 1	1.084
			→courtyard	= 1	1.002

Syntax 44: d-junction-entrance-?

House 1					
d	→junction	→entrance	→stairs	= 1	0.914
House 2, 3					
d	→junction	→entrance	→0		
House 4					
d	→junction	→entrance	→stairs	= 1	0.895
			→courtyard	= 1	0.760
			→terrace	= 1	0.964
House 5					
d	→junction	→entrance	→courtyard	= 1	1.341
House 6					
d	→junction	→0			

Syntax 45: d-junction-circulation-?

House 1					
d	→junction	→circulation	→terrace	= 1	0.978
House 2					
d	→junction	→circulation	→terrace	= 3	1.112
House 3					
d	→junction	→circulation	→terrace	= 5	1.239
House 4					
d	→junction	→circulation	→terrace	= 7	0.816
			→courtyard	= 4	0.841
House 5					
d	→junction	→circulation	→stairs	= 2	0.947
			→courtyard	= 1	0.855
House 6					
d	→junction	→0			

Syntax 46: d-junction-living area-?

House 1, 2, 4, 5					
d	→junction	→living area	→0		
House 3					
d	→junction	→living area	→veranda	= 7	1.288
House 6					
d	→junction	→0			

Syntax 47: d-junction-foyer-?

House *1, 2, 3*					
d	→junction	→foyer	→0		
House 4					
d	→junction	→foyer	→veranda	= 1	0.808

House 5

d	→junction	→foyer	→room	= 1	0.882

House 6

d	→junction	→0

Syntax 48: d-place-living area-?

House 1

d	→place	→living area	→terrace	= 1	0.763

House 2, 6

d	→place	→0

House 3

d	→place	→living area	→terrace	= 3	1.595
			→veranda	= 3	1.511

House 4

d	→place	→living area	→terrace	= 3	0.874
			→courtyard	= 2	0.778
			→room	= 1	0.737

House 5

d	→place	→living area	→terrace	= 1	1.078
			→courtyard	= 1	0.749

Syntax 49: d-place-dining hall-?

House 1, 4, 5

d	→place	→dining hall	→0

House 2, 6

d	→place	→0

House 3

d	→place	→dining hall	→pavilion	= 1	1.282

Syntax 50: d-place-garden-?

House 1, 3, 5

d	→place	→garden	→0

House 2, 6

d	→place	→0

House 4

d	→place	→garden	→terrace	= 2	0.771

Syntax 51: d-place-dining area-?

House 1, 3

d	→place	→dining area	→0

House 2, 6

d	→place	→0

House 4

d	→place	→dining area	→room	= 1	0.850

House 5

d	→place	→dining area	→courtyard	= 1	0.927

Syntax 52: d-place-kitchen-?

House 1, 3					
d	→place	→kitchen	→0		
House 2, 6					
d	→place	→0			
House 4					
d	→place	→kitchen	→room	= 1	0.798
House 5					
d	→place	→kitchen	→room	= 1	0.992

Syntax 53: d-place-living room-?

House 1, 3, 5					
d	→place	→living room	→0		
House 2, 6					
d	→place	→0			
House 4					
d	→place	→living room	→room	= 1	0.763

Syntax 54: d-place-storage-?

House 1, 3, 5					
d	→place	→storage	→0		
House 2, 6					
d	→place	→0			
House 4					
d	→place	→storage	→room	= 1	0.735

Syntax 55: d-place-bedroom-?

House 1, 3, 5					
d	→place	→storage	→0		
House 2, 6					
d	→place	→0			
House 4					
d	→place	→bedroom	→room	= 1	0.732

Table 7.3 Relations in houses 1-6

Relational syntax of temples 1-6

Structure	Experience	Function	Arch. element	No. of space	Integration value
Syntax 1: a-passage-circulation-?					
Temple 1, 3, 5, 6					
a	→passage	→0			
Temple 2					
a	→passage	→circulation	→pavilion	= 2	0.503
			→stairs	= 1	0.370
Temple 4					
a	→passage	→circulation	→terrace	= 2	0.515
Syntax 2: a-junction-circulation-?					
Temple 1					
a	→junction	→circulation	→terrace	= 47	0.815
			→hallway	= 10	0.460
Temple 2					
a	→junction	→circulation	→terrace	= 116	0.551
			→courtyard	= 24	0.766
			→hallway	= 4	0.386
Temple 3, 4, 6					
a	→junction	→circulation	→0		
Temple 5					
a	→junction	→circulation	→terrace	= 8	0.678
Syntax 3: a-junction-orientation-?					
Temple 1					
a	→junction	→orientation	→window	= 44	0.570
Temple 2					
a	→junction	→orientation	→window	= 32	0.429
Temple 3					
a	→junction	→orientation	→0		
Temple 4					
a	→junction	→orientation	→window	= 10	0.556
Temple 5					
a	→junction	→orientation	→window	= 8	0.494
Temple 6					
a	→junction	→orientation	→window	= 8	0.618
Syntax 4: a-junction-prayer space-?					
Temple 1, 3, *4, 5, 6*					
a	→junction	→prayer space	→0		
Temple 2					
a	→junction	→prayer space	→terrace	= 6	0.443
Syntax 5: a-place-garden-?					
Temple 1					
a	→place	→0			
Temple 2					
a	→place	→garden	→courtyard	= 22	0.537

Temple 3, *4, 5, 6*

a	→place	→garden	→0		

Syntax 6: a-place-rest area-?

Temple 1

a	→place	→0			

Temple 2

a	→place	→rest area	→courtyard	= 17	0.683

Temple 3, *4, 5, 6*

a	→place	→rest area	→0		

Syntax 7: a-place-prayer space-?

Temple 1

a	→place	→0			

Temple 2

a	→place	→prayer space	→pavilion	= 2	0.513

Temple 3, 4, 5

a	→place	→prayer space	→0		

Temple 6

a	→place	→prayer space	→terrace	= 3	0.526

Syntax 8: a-place-prayer hall-?

Temple 1

a	→place	→0			

Temple 2, 5, 6

a	→place	→prayer hall	→0		

Temple 3

a	→place	→prayer hall	→hall	= 1	0.540

Temple 4

a	→place	→prayer hall	→room	= 4	0.658

Syntax 9: a-place-storage-?

Temple 1

a	→place	→0			

Temple 2, 3, 5, 6

a	→place	→storage	→0		

Temple 4

a	→place	→storage	→room	= 2	0.645

Syntax 10: a-place-belfry-?

Temple 1

a	→place	→0			

Temple 2, 3, 6

a	→place	→belfry	→0		

Temple 4

a	→place	→belfry	→pavilion	= 1	0.448

Temple 5

a	→place	→belfry	→terrace	= 2	0.763

Syntax 11: b-passage-circulation-?

Temple 1, 3					
b	→0				
Temple 2					
b	→passage	→circulation	→hallway	= 4	0.433
Temple 4					
b	→passage	→circulation	→stairs	= 3	0.687
Temple 5					
b	→passage	→circulation	→stairs	= 1	0.738
Temple 6					
b	→passage	→circulation	→stairs	= 1	0.578

Syntax 12: b-junction-circulation-?

Temple 1, 3					
b	→0				
Temple 2					
b	→junction	→circulation	→doorway	= 1	0.389
Temple 4					
b	→junction	→circulation	→doorway	= 1	0.714
Temple 5					
b	→junction	→circulation	→terrace	= 4	0.659
Temple 6					
b	→junction	→circulation	→terrace	= 1	0.497

Syntax 13: b-place-rest area-?

Temple 1, 3					
b	→0				
Temple 2					
b	→place	→rest area	→courtyard	= 6	1.221
Temple 4, 5, 6					
b	→place	→0			

Syntax 14: c-passage-entrance-?

Temple 1					
c	→passage	→entrance	→gateway	= 24	0.881
Temple 2, 4, 5					
c	→passage	→entrance	→0		
Temple 3					
c	→passage	→entrance	→gateway	= 1	0.745
Temple 6					
c	→passage	→entrance	→gateway	= 3	0.697

Syntax 15: c-passage-circulation-?

Temple 1					
c	→passage	→circulation	→stairs	= 12	0.773
			→courtyard	= 12	0.585
			→cloister	= 8	0.776
			→terrace	= 2	0.598
			→hallway	= 1	0.492

Temple 2

c	→passage	→circulation	→stairs	= 48	0.556
			→terrace	= 38	0.591
			→courtyard	= 25	0.700
			→pavilion	= 6	0.572

Temple 3

c	→passage	→circulation	→cloister	= 15	0.681
			→stairs	= 14	0.615
			→hallway	= 1	0.607
			→courtyard	= 2	0.564

Temple 4

c	→passage	→circulation	→terrace	= 19	0.647
			→stairs	= 9	0.771
			→courtyard	= 1	0.496

Temple 5

c	→passage	→circulation	→terrace	= 23	0.705
			→stairs	= 15	0.712
			→hallway	= 2	0.521

Temple 6

c	→passage	→circulation	→stairs	= 7	0.708
			→terrace	= 1	0.688

Syntax 16: c-junction-circulation-?

Temple 1

c	→junction	→circulation	→cloister	= **236**	0.835
			→terrace	= 47	0.903
			→doorway	= 36	0.720
			→hallway	= 4	0.460

Temple 2

c	→junction	→circulation	→cloister	= **210**	0.676
			→doorway	= 67	0.480
			→terrace	= 51	0.534
			→courtyard	= 17	0.652
			→pavilion	= 2	0.717
			→hallway	= 2	0.398

Temple 3

c	→junction	→circulation	→cloister	= **21**	0.716
			→terrace	= 13	0.784
			→hallway	= 5	0.560
			→doorway	= 4	0.666
			→courtyard	= 4	0.534

Temple 4

c	→junction	→circulation	→terrace	= **35**	0.729
			→stairs	= 3	0.677
			→courtyard	= 2	0.555

Temple 5

c	→junction	→circulation	→terrace	= 18	**0.789**
			→stairs	= 5	0.542

			→doorway	= 2	0.596
Temple 6					
c	→junction	→circulation	→doorway	= 3	0.712
			→stairs	= 2	0.578
			→terrace	= 1	0.690

Syntax 17: c-junction-entrance-?

Temple 1					
c	→junction	→entrance	→gateway	= 8	1.063
			→terrace	= 4	0.575
Temple 2					
c	→junction	→entrance	→gateway	= 62	0.716
Temple 3					
c	→junction	→entrance	→gateway	= 5	0.697
Temple 4					
c	→junction	→entrance	→gateway	= 1	0.662
Temple 5					
c	→junction	→entrance	→gateway	= 2	0.641
Temple 6					
c	→junction	→entrance	→0		

Syntax 18: c-junction-office-?

Temple 1, 3, *4, 5, 6*					
c	→junction	→office	→0		
Temple 2					
c	→junction	→office	→room	= 57	0.538

Syntax 19: c-junction-prayer hall-?

Temple 1, 5, 6					
c	→junction	→prayer hall	→0		
Temple 2					
c	→junction	→prayer hall	→room	= 19	0.503
Temple 3					
c	→junction	→prayer hall	→cloister	= 2	0.868
Temple 4					
c	→junction	→prayer hall	→hall	= 1	0.564

Syntax 20: c-junction-storage-?

Temple 1, 3, *4, 5, 6*					
c	→junction	→storage	→0		
Temple 2					
c	→junction	→storage	→room	= 8	0.445

Syntax 21: c-junction-foyer-?

Temple *1, 2, 3,* 4, 6					
c	→junction	→foyer	→0		
Temple 5					
c	→junction	→foyer	→hall	= 2	0.577

Syntax 22: c-place-rest area-?

Temple 1					
c	→place	→rest area	→courtyard	= 8	0.782
Temple 2					
c	→place	→rest area	→courtyard	= 3	0.751
Temple 3, 4, 6					
c	→place	→0			
Temple 5					
c	→place	→rest area	→0		

Syntax 23: c-place-storage-?

Temple 1, 5					
c	→place	→storage	→0		
Temple 2					
c	→place	→storage	→room	= 5	0.585
Temple 3, 4, 6					
c	→place	→0			

Syntax 24: c-place-prayer space-?

Temple 1					
c	→place	→prayer space	→0		
Temple 2					
c	→place	→prayer space	→pavilion	= 4	0.434
Temple 3, 4, 6					
c	→place	→0			
Temple 5					
c	→place	→prayer space	→terrace	= 3	0.692

Syntax 25: c-place-prayer hall-?

Temple 1, 5					
c	→place	→prayer hall	→0		
Temple 2					
c	→place	→prayer hall	→hall	= 2	0.444
Temple 3, 4, 6					
c	→place	→0			

Syntax 26: d-passage-circulation-?

Temple 1					
d	→passage	→circulation	→cloister	= 48	0.860
			→terrace	= 39	0.892
			→courtyard	= 32	0.790
			→room	= 16	0.732
			→hallway	= 3	0.514
Temple 2					
d	→passage	→circulation	→terrace	= 37	0.581
			→courtyard	= 17	0.768
			→cloister	= 16	0.699
			→hallway	= 3	0.411
Temple 3					
d	→passage	→circulation	→terrace	= 9	0.920

			→courtyard	= 6	0.613
			→hallway	= 2	0.633
Temple 4					
d	→passage	→circulation	→terrace	= 18	0.843
			→courtyard	= 2	0.555
Temple 5					
d	→passage	→circulation	→terrace	= 27	0.769
Temple 6					
d	→passage	→circulation	→terrace	= 10	0.765

Syntax 27: d-passage-foyer-?

Temple 1, 3, *4, 5, 6*					
d	→passage	→foyer	→0		
Temple 2					
d	→passage	→foyer	→room	= 27	0.588

Syntax 28: d-passage-office-?

Temple 1, 3, *4, 5, 6*					
d	→passage	→office	→0		
Temple 2					
d	→passage	→office	→room	= 9	0.604

Syntax 29: d-passage-prayer hall-?

Temple 1, *4, 5, 6*					
d	→passage	→prayer hall	→0		
Temple 2					
d	→passage	→prayer hall	→room	= 6	0.549
Temple 3					
d	→passage	→prayer hall	→hall	= 3	0.807

Syntax 30: d-passage-storage-?

Temple 1, 3, *4, 5, 6*					
d	→passage	→storage	→0		
Temple 2					
d	→passage	→storage	→room	= 4	0.483

Syntax 31: d-junction-circulation-?

Temple 1					
d	→junction	→circulation	→cloister	= 36	0.930
			→terrace	= 34	0.848
Temple 2					
d	→junction	→circulation	→terrace	= 26	0.608
			→courtyard	= 20	0.711
			→cloister	= 8	0.710
			→doorway	= 2	0.431
			→hallway	= 2	0.410
Temple 3					
d	→junction	→circulation	→cloister	= 8	0.846
			→terrace	= 2	0.843
			→courtyard	= 1	0.731

Temple 4					
d	→junction	→circulation	→terrace	= 8	0.817
			→courtyard	= 1	0.630
Temple 5					
d	→junction	→circulation	→terrace	= 5	0.568
			→stairs	= 2	0.675
Temple 6					
d	→junction	→circulation	→terrace	= 8	0.721
			→stairs	= 1	0.743

Syntax 32: d-junction-foyer-?

Temple 1, 2, 4, 5					
d	→junction	→foyer	→0		
Temple 3					
d	→junction	→foyer	→cloister	= 3	0.770
Temple 6					
d	→junction	→foyer	→hall	= 2	0.734

Syntax 33: d-junction-entrance-?

Temple 1, 2, *4, 5, 6*					
d	→junction	→entrance	→0		
Temple 3					
d	→junction	→entrance	→gateway	= 1	0.716

Syntax 34: d-junction-prayer hall-?

Temple *1, 2, 3*, 5, 6					
d	→junction	→prayer hall	→0		
Temple 4					
d	→junction	→prayer hall	→hall	= 1	0.632

Syntax 35: d-place-prayer hall-?

Temple 1					
d	→place	→prayer hall	→room	= 8	0.750
			→hall	= 1	0.489
Temple 2					
d	→place	→prayer hall	→room	= 20	0.536
			→hall	= 1	0.410
Temple 3					
d	→place	→prayer hall	→hall	= 2	0.579
			→cloister	= 1	0.903
Temple 4					
d	→place	→prayer hall	→hall	= 1	0.642
Temple 5					
d	→place	→prayer hall	→hall	= 1	0.584
Temple 6					
d	→place	→prayer hall	→hall	= 1	0.762

Syntax 36: d-place-prayer space-?

Temple 1					
d	→place	→prayer space	→room	= 8	0.707
			→terrace	= 3	1.051
Temple 2					
d	→place	→prayer space	→terrace	= 4	0.467
Temple 3					
d	→place	→prayer space	→0		
Temple 4					
d	→place	→prayer space	→terrace	= 1	0.828
			→hall	= 1	0.596
Temple 5					
d	→place	→prayer space	→terrace	= 3	0.579
			→hall	= 1	0.521
Temple 6					
d	→place	→prayer space	→hall	= 1	0.706

Syntax 38: d-place-bench-?

Temple 1					
d	→place	→bench	→terrace	= 8	0.573
Temple 2, 3, *4, 5, 6*					
d	→place	→bench	→0		

Syntax 39: d-place-foyer-?

Temple 1					
d	→place	→foyer	→terrace	= 4	0.701
Temple 2, 3, *4, 5, 6*					
d	→place	→foyer	→0		

Syntax 40: d-place-office-?

Temple 1, 3, *4, 5, 6*					
d	→place	→office	→0		
Temple 2					
d	→place	→office	→room	= 60	0.569

Syntax 41: d-place-storage-?

Temple 1, 3, *4, 5, 6*					
d	→place	→storage	→0		
Temple 2					
d	→place	→storage	→room	= 6	0.455

Syntax 42: d-place-garden-?

Temple 1, 3, *4, 5, 6*					
d	→place	→garden	→0		
Temple 2					
d	→place	→garden	→courtyard	= 7	0.706

Table 7.4 Relations in temples 1-6

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